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Elements of the Heat-Treatment of Steel

Operations in Heat Treatment—Changes in Structure While Heating—Changes Produced by Tempering and Hardening—Seasoning—Effect of Carburization

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MODERN practice of heat-treatment has become quite complex and necessitates a definite knowledge of the structural changes taking place in the metal and how they may be controlled. It is the purpose of this article to deal, of necessity briefly, with the fundamentals of this process in its various phases and to point out some of the factors involved in successfully carrying out the operations involved. This discussion will, moreover, be limited to plain carbon steels, but will later be supplemented by more detailed discussions, both as to methods and special alloys.

Heat-treatment may be considered a process by which, intelligently applied, the properties of metals are varied and controlled within well-defined limits for the benefit of mankind. The operations which will be considered are as follows: (1) Normalizing and annealing; (2) hardening; (3) tempering; (4) seasoning; (5) casehardening.

Common to all these operations are heating and cooling; thus it will be well first to consider what occurs in iron and steels when heated and cooled. In order to obtain a proper conception of changes which take place it must be borne in mind that steel is essentially an alloy of iron and carbon. However, certain impurities such as manganese, phosphorus, sulphur and silicon are always present in the commercial product, due to peculiarities of manufacture, but their effects may be ignored in this preliminary discussion as the proportions usually found in plain carbon steels are small and held within close limits.

Thermal Transformations

Let it be assumed for the moment that a furnace is available which may be heated and cooled at a definite and practically constant rate; also that the relation between rate of heating, size of this furnace and the sample which is to be heated, is such that the latter will be uniformly heated throughout with the furnace. If then a piece of pure iron is placed in this unit it will steadily increase in temperature with time until about 767 deg. C. (1,411 deg. F.) is reached, when it will be noticed that the rate of rise in temperature of the sample has decreased despite the uniform rate of increase in temperature of the furnace. But soon the rate of temperature change of the iron increases and when the sample has once more reached the temperature of the furnace the two again change at equal rates. At about 910 deg. C. (1,670 deg. F.) a similar effect is observed but this time of greater magnitude.

These thermal effects, or, as they are commonly called "thermal transformations," in pure iron are of the greatest importance and are accompanied by physical changes. They are commonly designated as the Ac_2 and Ac_3 transformations while the reverse changes which take place on cooling are referred to respectively as Ar_2 and Ar_3.

Typical heating and cooling curves for pure iron are shown in Fig. 1. There it will be noted that the Ac_2 transformation (which is accompanied by loss of magnetism) occurs at almost the same temperature as Ar_2 (where the iron regains its magnetic properties), whereas A_3 occurs at a distinctly lower temperature on cooling than on heating. This phenomenon which indicates a resistance of the metal to transformation is often referred to as "lag" or "hysteresis."

If carbon is added to pure iron (by definition this is essentially steel) a third thermal change is observed at a temperature below A_2 which is designated Ac_1 on heating and Ar_1 on cooling. It likewise shows lag and this lag increases in magnitude with the carbon content, which immediately suggests that it is directly associated with a carbon change. If heating and cooling curves of steels of different carbon contents are obtained and the temperatures of occurrence of the transformations plotted against the carbon content, as shown in Fig. 2, that portion of the well-known iron-carbon equilibrium diagram is obtained which is in reality the basis of the heat-treatment of steels.

Structure of Carbon Steels

The carbon in steel is present as a definite compound Fe_3C (iron carbide) called cementite and it is the condition of the cementite which controls the physical properties of steel. At room temperature the carbide is in its stable and free condition and may be readily distinguished under the microscope from the pure iron (called ferrite). When steel of less than 0.85 per cent carbon is heated the cementite goes into solution in part of the iron beginning at the temperature of the Ac_1 transformation. With further increase in temperature this solution absorbs more and more of the remaining ferrite until at the Ac_3 transformation the last traces are absorbed and the entire mass is a single solid solution (called austenite or gamma (γ) iron. At Ac_3 the iron also changes from its stable form at room temperature (alpha (α) iron) to beta (β) iron which is non-magnetic. In heating steels containing more than 0.85 per cent carbon the solution of cementite in iron absorbs the excess carbide as the temperature is raised in a manner similar to that explained above for ferrite in low-carbon steels.

On cooling the reverse reactions take place. For

example, when a steel containing 0.85 per cent carbon is slowly cooled from a high temperature the solid solution previously referred to is retained until a temperature of about 700 deg. C. (1,292 deg. F.) is reached when a change of the entire mass to a finely divided mechanical mixture of ferrite and cementite, called pearlite, takes place. As the proportions of carbon and iron in the pearlite are constant for steels of various carbon contents, those alloys containing less than 0.85 per cent carbon have an excess of ferrite which, in cooling, precipitates at temperatures represented by the line *GOS*, Fig. 2. More and more of the excess ferrite is released by the solid solution as the steel cools until at 700 deg. C. (1,292 deg. F.) there remains just enough to form pearlite with the cementite. Steels containing more than 0. 85 per cent carbon have an excess of cementite which in cooling begins to precipitate at temperatures represented by the line *SE*, Fig. 2. To summarize, the line *GOS* represents the precipitation of the excess ferrite, *SE* the cementite and *P'S'K'* the pearlite.

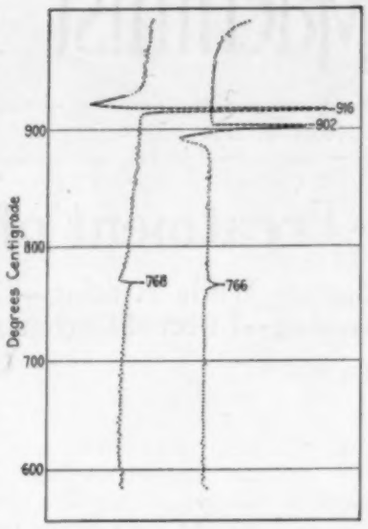


FIG. 1. HEATING AND COOLING CURVES OF PURE IRON (INVERSE RATE METHOD)

Physical Properties of Structures in Transition

The change of the solid solution (austenite) to pearlite takes place gradually and the main structures which may be recognized under the microscope in this transition are called, in order, martensite, troostite and sorbite. Microphotographs of all these are shown in Figs. 3 to 7 inclusive.

Each structure is characterized by definite physical properties. Austenite is practically non-magnetic, has medium strength and very low elastic limit, but has high ductility and is of medium-high hardness. Martensite is very hard (its hardness being second only to cementite) and has high strength but is extremely brittle, while troostite has medium strength and is somewhat less brittle. Sorbite is somewhat softer than troostite but extremely tough, while pearlite is the softest of the five structures mentioned and is only harder than pure iron (ferrite).

It must be evident, inasmuch as these changes take place gradually, that if it is possible in any manner to stop the transition from austentite to pearlite at any given stage, the structure of the steel and therefore its properties may be varied. Rapid cooling as by quenching in water tends to preserve the structure of the solid solution because there is insufficient time for the complete change to pearlite while the steel is quickly brought from the high temperature to that of the room. The resulting structure may be martensitic and the steel extremely hard. On the other hand, slow cooling allows sufficient time for the complete change to pearlite and the steel is soft and ductile and easily machined while between these two extremes there are rates of cooling which give intermediate properties.

When steel is heated to just above the upper critical range a new crystalline arrangement is obtained and the previous structure, stable at room temperature, is obliterated. The grains of the solid solution (austenite) are small, but they will grow if the steel is held for some time at the high temperature. Increase in grain size also takes place more rapidly with greater rise in temperature, and this coarseness is maintained when the steel is cooled. Coarse grain is, therefore, an evidence of overheating (shown in Fig. 8). It may be remedied by allowing the steel to cool blow Ar_1, for it is here that the carbide precipitates, and then reheating

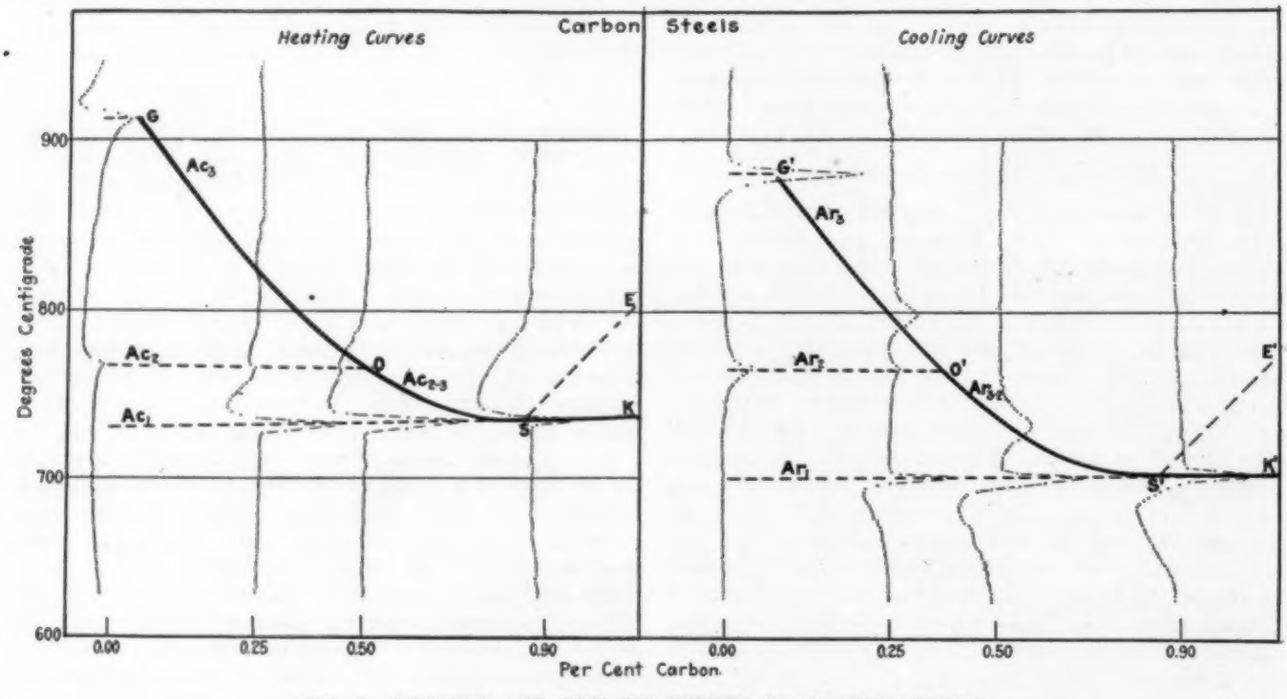


FIG. 2. HEATING AND COOLING CURVES OF CARBON STEELS

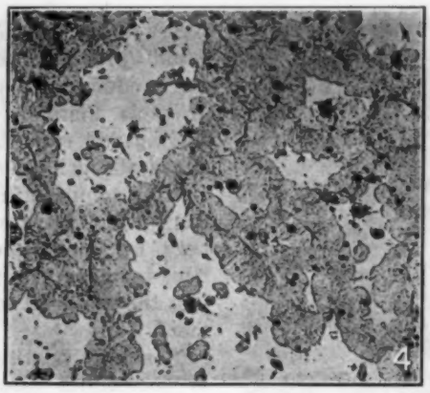
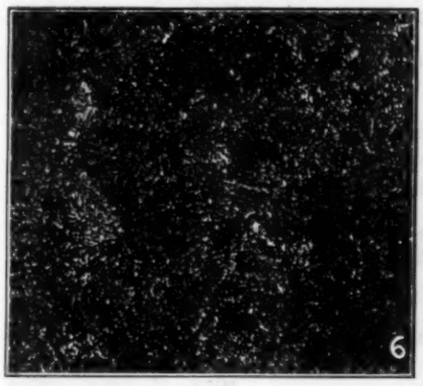
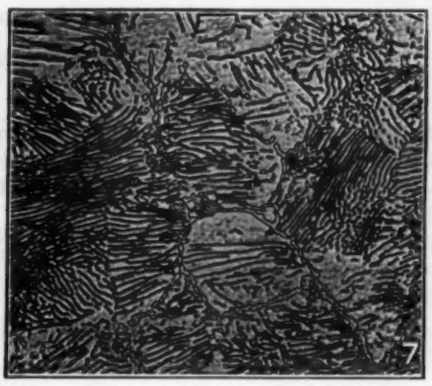


FIG. 3. AUSTENITE (WHITE) AND MARTENSITE (DARK), SHOWING CHARACTERISTIC NEEDLE-LIKE STRUCTURE OF THE LATTER. OBTAINED IN RAPID COOLING FROM HIGH TEMPERATURE. FIG. 4. TROOSTITE (DARK). OBTAINED IN QUENCHING FROM A HIGH TEMPERATURE AT A MORE MODERATE RATE THAN FOR FIG. 3. FIG. 5. SORBITE AND PEARLITE. OBTAINED IN THE SHANK OF A COLD-CHISEL AFTER QUENCHING, THE POINT OF WHICH WAS MARTENSITE





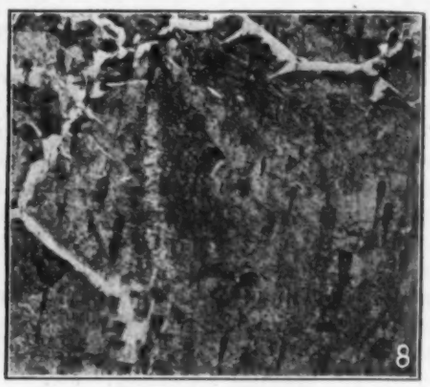


FIG. 6. SORBITE IN HIGH CARBON STEEL. OBTAINED IN TEMPERING THE HARDENED ALLOY. FIG. 7. PEARLITE, SHOWING LAMINATED STRUCTURE (FERRITE AND CEMENTITE) CHARACTERISTIC AT HIGH MAGNIFICATIONS. OBTAINED BY VERY SLOW COOLING FROM A HIGH TEMPERATURE. FIG. 8. OVERHEAD STEEL, SHOWING EXTREMELY COARSE GRAINS OF PEARLITE SURROUNDED BY FERRITE (WHITE)

to a temperature just above the line *GOSK* in Fig. 2. This will again bring the carbon into solution, the resulting structure being shown in Fig. 9. A graphical representation of these considerations is given in Fig. 10. Theoretically the best temperature to use is one just above the line *GOSK* of Fig. 2, for in this manner the finest grain size will be obtained, but practically the best results are often obtained by exceeding the theoretical values considerably. However, if the metal is taken above the range of proper heating and becomes "burned" there is no remedy other than remelting and production of new steel.

One of the most important factors in heat-treatment which must be considered in all operations is the size (and shape) of the material. In heating large masses rapidly the surface becomes considerably hotter than the interior, for it takes time for the heat to diffuse throughout the steel, and this results in a greater expansion at the surface than near the center. If the material has low heat conductivity, preventing rapid diffusion, and a high coefficient of expansion, the stresses set up by the superficial heating may exceed the strength of the metal and it will rupture. The same principles also apply to cooling; in fact, frequently some difficulty is encountered from minute quenching cracks which result from even moderate rates of cooling large masses. While such defects are often hard to detect they form a source of weakness and when the material is subjected to severe service may ultimately result in failure.

The effect of size on the physical properties of heat-treated steel is marked. A steel which, when water quenched in a half-inch round section from a high temperature is martensitic, will when similarly treated in a larger section, for example one-inch round, have a different structure and therefore different properties. The one-inch section may be martensitic at the surface but the interior will be largely troostitic and may even show evidence of sorbite at the center.

An example of the magnitude of the effect of size on the tensile properties of steel under heat-treatment is shown in Table I, below.

TABLE I. STEEL OIL QUENCHED FROM 871° C. (1,600° F.) AND TEMPERED AT 555° C. (1,030° F.)

Size	Tensile Str. Lb. per Sq.In.	Elast. Lim. Lb. per Sq.In.	Per Cent El. in 2 In.	Per Cent Red. of Area
½ in. rd.	130,000	95,000	21.5	58.0
1 in. rd.	123,300	86,000	23.7	61.3

With increase in cross-section, it is seen that the elastic properties, strength and hardness are lowered, while the ductility increases.

The shape of the material is likewise an important factor in treatment. Sharp corners in machined or partly machined forgings are frequently a source of difficulty, as are also more or less abrupt changes from large to small sections. The latter may become cold while the larger portion of the mass remains at a relatively high temperature. Such large temperature differences, even though only momentary, set up internal strains of considerable magnitude which are quite liable to cause fracture. Further reference to these factors will be made in the following paragraphs when

considering in more detail the operations of annealing, hardening, etc. Both normalizing and annealing consists in heating the steel to a temperature above the thermal transformations and slowly cooling. Normalizing refers to air cooling while annealing is properly applied when a slower rate, as cooling in a furnace, is used. These terms are, however, often loosely applied. Annealing is at times used in place of the more commonly employed terms "tempering" and "drawing," and also for heatings carried out between cold passes in production of seamless tubes, cold-finished rods, etc. In these cases the temperatures employed are usually either below or within the thermal critical ranges and the material is cooled at varying rates. In the present discussion the definitions given at the beginning of this paragraph will be adhered to and a special qualifying phrase will be used when a special modification is referred to as "inter-pass annealing," "partial annealing," etc.

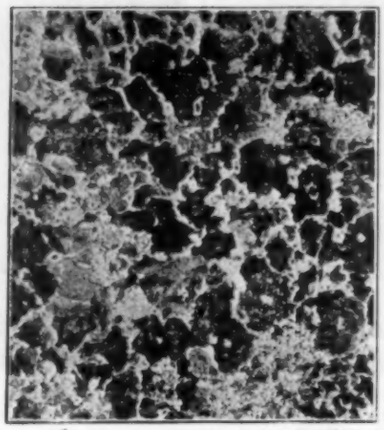


FIG. 9. OVERHEATED STEEL
After first cooling it was reheated to above the A 3 transformation. Not yet wholly refined but in better condition than the steel shown in Fig. 8.

The purpose of either normalizing or annealing may be one or more of the following: (1) To refine the grain of the steel; (2) to soften for machining; (3) to remove stresses due to quenching, cold-working, etc.; (4) to produce definite physical properties.

To refine the grain of the steel all that is theoretically necessary is to heat to a temperature slightly in excess of the line *GOSK* of Fig. 2 and allow to cool. In actual practice, however, this process may be much more complex, depending upon the material and its previous history. In normalizing or annealing steel castings of refractory structure, temperatures slightly above the critical ranges maintained for a long time, or high temperatures for a short time, are often insufficient to obliterate the original cast structure and it then becomes necessary to considerably increase the time-temperature relationship and frequently to subject the material to a double or more complicated treatment.

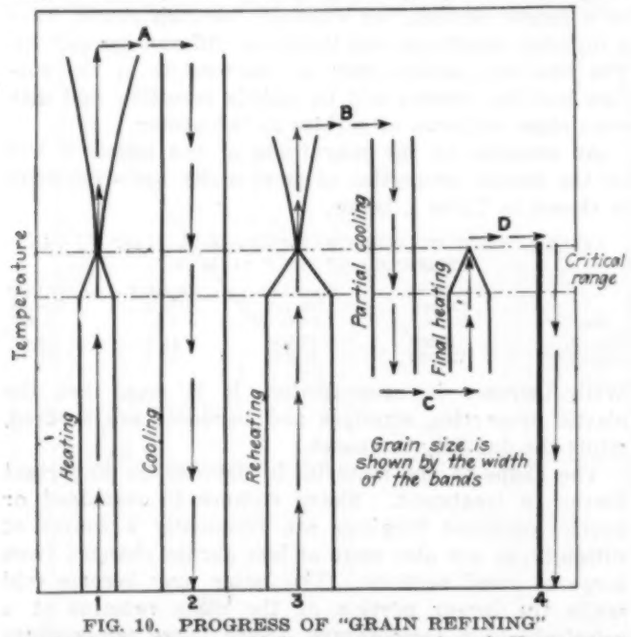


FIG. 10. PROGRESS OF "GRAIN REFINING"
1. Original structure. Medium coarse grain. 2. Very coarse structure, resulting from severe overheating (*A*). 3. On reheating to *B* this structure is partially refined but the temperature is too high for refinement. By cooling to a little below the critical range (*C*) and then finally heating to slightly above (*D*) the steel is brought into satisfactory condition and 4, grain is refined.
Note: Micrographs prepared in the Metallographic Section, Bureau of Standards, Washington, D. C.

A simple heating slightly above the transformations is sometimes also inadequate for the refinement of rolled or forged carbon steel in cases where this work has been finished at a somewhat low temperature. In order to completely remove all traces of "banding" in such rolled steel a preliminary quenching from a high temperature is sometimes used.

Softening for Machining and Removal of Stresses

To soften for machining or to remove stresses due to quenching, cold-working, etc., a temperature above the critical range is not necessary. In general, a "partial annealing" using a temperature of about 600 deg. C. (1,112 deg. F.) will be sufficient to remove stresses and soften for machining all steels of less than 0.85 per cent carbon. For higher carbon alloys slow cooling from a higher temperature through the A_1 transformation is greatly to be desired and more often necessary.

TABLE II. INFLUENCE OF RATE OF COOLING ON 0.50 PER CENT CARBON CYLINDER STEEL, 6-IN. ROUNDS

Treatment	Brinell Hardness	Remarks
Cooled in furnace from 843° C.....	126	Steel too soft; tore very badly.
Cooled in still air from 843° C..	143	Steel still soft and tearing, but better than 126 hardness.
Cooled in gentle air blast from 870° C..	159	Machines well; little tearing, except at higher cutting speeds.

When cooling from temperatures below the transformations the steel will not be in its best condition either for subsequent treatment or for machining, but of course the choice of temperature is dependent upon the previous history of the material, its composition and the properties desired.

In "partial annealing" the rate of cooling is immaterial, but when the critical ranges are exceeded the rate at which the steel passes through these is of greatest importance. The slowest rate of cooling from just above the critical range will give the softest steel but will not necessarily produce metal which is in the best condition for machining. A single example of this is shown in Table 2 from which it will be noted that the steel in its annealed and softest condition tore badly in the turning operation, whereas with the same metal subjected to a faster cooling, as in an air blast, this difficulty was removed. This point is of considerable importance for there is in general not as great care taken in these preliminary operations as in the hardening and tempering.

Production of Definite Physical Properties

In reality the foregoing discussion deals with particular phases of the production of definite physical properties by annealing and normalizing, but what will here be considered chiefly is control of properties ordinarily found in specifications for structural mate-

rials. While the same principles apply as in the previous dicussion it will probably be enlightening to have test values available.

In Table 3 are given approximate figures for the tensile properties of various grades of open hearth

TABLE III. APPROXIMATE TENSILE PROPERTIES OF ROLLED CARBON STEELS IN SMALL SECTIONS

Carbon Range, Per Cent	Elastic Limit Lb. per Sq.In.	Tensile Str., Lb. per Sq.In	Per Cent Elong. in 2 In.	Per Cent Red. of Area
0.08 to 0.18	30,000 35,000	45,000 58,000	34 30	70 60
0.18 to 0.28	35,000 41,000	58,000 68,000	30 25	60 50
0.32 to 0.40	44,000 49,000	70,000 82,000	23 20	45 38
0.45 to 0.55	51,000 56,000	88,000 98,000	20 13	36 30
0.53 to 0.63	52,000 58,000	90,000 105,000	20 12	32 28
0.70 to 0.80	74,000 84,000	133,000 145,000	11 7	15 10
0.80 to 0.95	74,000 84,000	135,000 150,000	9 6	15 10
0.90 to 1.10	80,000 90,000	147,000 162,000	8 5	15 6

TABLE IV. QUANTITATIVE EFFECTS OF VARIATIONS IN CHEMICAL COMPOSITION, SIZES OF MATERIAL AND TIME-TEMPERATURE RELATIONS IN HEATING AND COOLING

Per Cent Carbon	Treatment	Tensile Str. Lb. per Sq.In.	Yield Pt. Lb. per Sq.In.	Per Cent El. 2 In.	Per Cent Red. A.
0.14	As rolled	59,500	45,000	37.5	67.0
	Annealed 866° C.	54,500	31,000	39.5	67.0
0.46	As rolled	86,500	52,500	22.5	30.7
	Annealed 819° C.	79,500	48,000	28.5	46.2
0.71	As rolled	128,000	66,000	15.0	20.5
	Annealed 800° C.	111,500	46,500	16.5	24.0
1.01	As rolled	152,000	86,000	9.5	13.3
	Annealed 790° C.	99,400	53,800	24.0	36.2
0.25	As received	74,500	.....	12.7	25.3
	Annealed 720° C.				
	30 min.	64,500	40,800	32.5	62.7
	12 hours	63,000	35,400	31.0	57.3
	Annealed 900° C.				
	30 min.	66,000	38,700	32.5	54.8
	12 hours	66,100	56,100	29.0	57.5
0.47	As received	82,600	.....	6.2	18.8
	Annealed 720° C.				
	30 min.	73,500	48,400	29.0	58.6
	12 hours	65,600	26,300	30.5	42.7
	Annealed 900° C.				
	30 min.	72,700	40,400	28.0	46.3
	12 hours	67,000	57,200	30.0	43.5
0.95	As received	120,500	.....	7.0	5.6
	Annealed 720° C.				
	30 min.	88,000	.....	22.0	45.0
	12 hours	75,500	31,600	23.5	35.4
	Annealed 900° C.				
	30 min.	114,500	.....	10.0	15.4
	12 hours	107,000	80,900	11.9	11.0

NOTE.—Results taken from the Sixth Report of the Alloys Research Committee and "The Effect of Carbon on the Physical Properties of Heat Treated Carbon Steel," by J. H. Nead, T.A.I.M.E., 1915, p. 218.

steel as rolled. Where special properties are required after annealing or normalizing, a balance must be obtained between the chemical composition, size of material and the time-temperature relations in heating and cooling. The quantitative effect of some of these variables in individual cases is shown in Table 4. In view of the previous discussion the results should be self-explanatory.

(To be continued in next week's issue.)

A Mechanical Encyclopedia

BY NICHOLAS HEYMAN

On page 399 of *American Machinist* Albert F. Guyles comments on the suggestion relating to a "Loose-Leaf Mechanical Encyclopedia." The writer has been cutting up fourteen different trade papers for quite a time, and files these loose-leaf sheets in the manner related below. The method has given satisfaction and, above all, permits of a handy reference file that takes up but little room.

As each issue is received it is placed in a tray, to wait for an opportune time to be read. Each month those papers that have been examined are placed in a paper cutting machine and the bindings severed. In the absence of such a machine an ordinary sharp knife will do. The advertisements are cast aside and all articles are kept for examination and classification. In examining the articles, any of little value in the judgment of the reader are cast out.

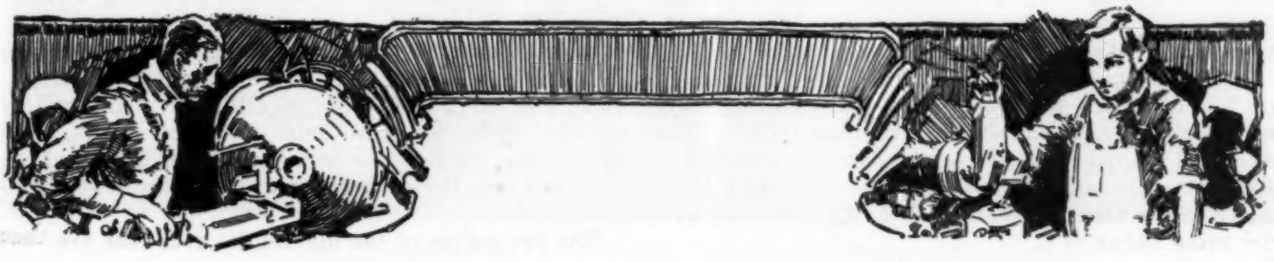
THE METHOD OF FILING

The scheme used in filing consists in putting the articles in heavy manila folders which are marked in the upper right-hand corner with a single letter. The folders run from A to Z and then start over again with a subscript; as A_0 to Z_0, A_1 to Z_1, etc. Each article is then marked in the upper right-hand corner with the letter of the folder and the sequence number of the article, viz: A_0—25. If the article covers more than one page, the several pages are fastened together and each sheet numbered with the article designation in case one page is torn from the article in handling and should go astray.

Now it sometimes happens that more than one article comes together, and quite frequently that a new article starts on the last page of the preceding one. In this instance the marking would be, for instance: B_0—4/6. This is taken to mean that in folder B_0, article No. 4 (fourth in sequence), has on its last pages articles Nos. 5 and 6; the latter complete or in part.

Now the last page is marked at its top thus: B_0—60 the number in the circle indicating that article 6 is back of article No. 4. If you looked for article No. 6 it would be found with the beginning on some other sheet. The number on the top of the page will indicate No. 4 in a circle which shows that No. 6 starts on the back of No. 4. Experience shows that from seventy-five to one hundred articles such as one finds in trade papers make the folder just stout enough to be conveniently carried.

It is quite evident that the value of this method of filing articles depends entirely on the care with which the articles are cross-indexed. Any article or subject is easily found by reference to the cross-index file. The writer at present has 35,000 articles covering a variety of subjects, and has been paid for the labor spent in its upkeep many times over.



Methods and Tools Used in Machining the Peerless Differential Carrier and Gear Case

Turret Lathe Tooling for Special Jobs—Drilling Fixture for Rapid Handling of Work—Interesting Gages for Surfaces Which Are Not Easy of Access

BY FRED H. COLVIN
Editor, *American Machinist*

THE machining of the differential carrier, which supports the differential case, and is in turn supported by the rear axle housing, is accomplished by the methods shown in the accompanying illustrations. The sequence of operations is:

Operation 1—Bore large holes, counterbore, tap, face flange and cap bearings.
Operation 2—Drill fourteen holes; ream two.
Operation 3—Drill three holes, one for ¼-in. pipe tap.
Operation 4—Spot-face holes in flange.
Operation 5—Face to length and chamfer.
Operation 6—Spot-face both sides of two holes.
Operation 7—Countersink and tap four holes.
Operation 8—Drill and tap three holes for plugs.
Operation 9—Mill slot in bosses.
Operation 10—Face flange.
Operation 11—Bolt bearing caps to carrier and tap ½-in. hole.
Operation 12—Final inspection.

The first major operation is to bore and face the carrier in the bell shaped chuck shown in Fig. 1. The tooling is done with typical Gisholt equipment, utilizing the turret toolpost as well as the main turret in order to insure the necessary accuracy of the various surfaces.

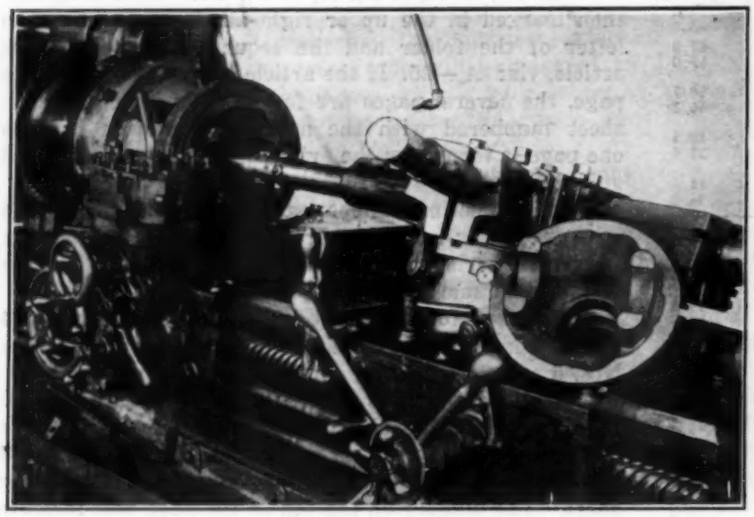
Locating the carrier by the face of the bolt flange, the bolt holes are drilled under the Baush multiple spindle drilling machine shown in Fig. 2. This also drills the holes for tapping to receive the bolts which hold the caps. The drill bushings for these holes are held in the projections *A* and *B*. The ears which hold the bearings project up through the fixture as shown at *C* and *D*. It will also be noted that a reamer is positioned at *E* for reaming one hole for a dowel pin fit which locates the carrier in future operations.

After the caps, which have been machined previously, are bolted in place as shown in Fig. 3, the bearing seats are bored in the double-headed machine shown. The carrier is located by means of the dowel *A* and held in position by the bolt and C-washer as at *B*. Both bearing seats are then bored simultaneously, a finished carrier being shown at *C*.

The machining of the differential gear case involves a number of interesting operations, the sequence being as follows:

Operation 1—Turn, face, counterbore, form radius and bore.
Operation 2—Turn, face and chamfer.
Operation 3—Drill eight ⅛-in. holes.
Operation 4—Drill eight holes for ⅜-16 taps.
Operation 5—Counterbore sixteen holes.
Operation 6—Tap eight ⅜-16 holes.
Operation 7—Mill oil grooves.
Operation 8—Bolt halves together.
Operation 9—Grind 2.0625 diameter.
Operation 10—Grind flange diameter.
Operation 11—Drill and ream four ⅜-in. holes.
Operation 12—Inspect.

The first operation on the flange part is performed in a Potter & Johnson machine as shown in Fig. 4. This machine turns, bores, faces, counterbores, forms the radius and bores the inside of the case. The tools are shown in the turret, and a completed piece is on the cross-slide which shows the part of the case that carries the ring gear on its large flange. By the second operation on this piece the back side is machined and as can be seen in Fig. 5, three tools in the cross-slide as well as those in the turret are utilized.



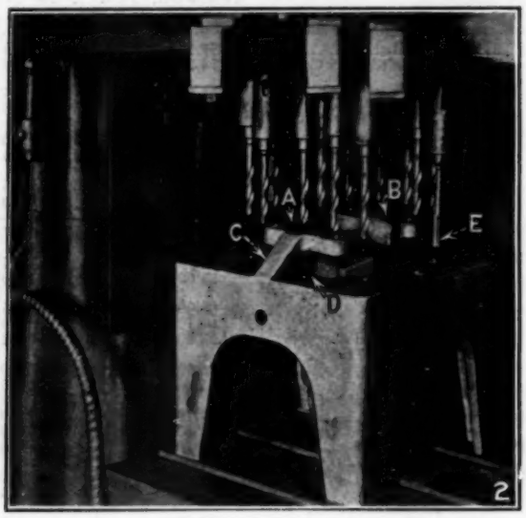
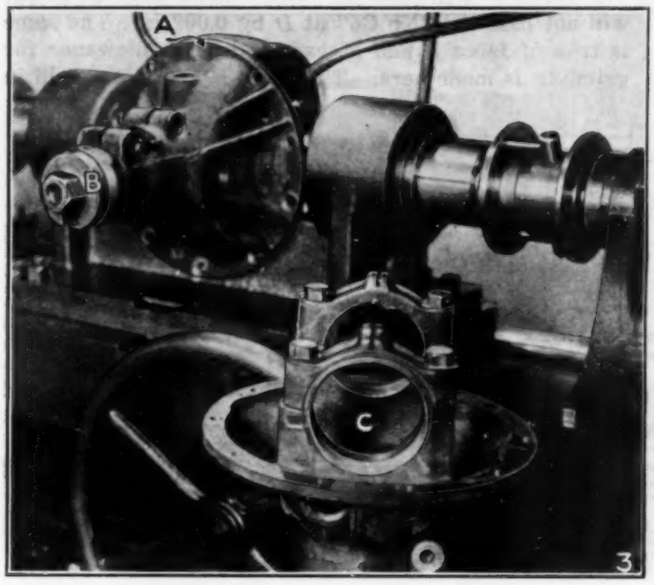


FIG. 1. BORING AND FACING DIFFERENTIAL CARRIER. FIG. 2. DRILLING HOLES IN FLANGE AND BEARINGS

The drilling heads shown in Fig. 6 are both mounted on a Cincinnati-Bickford drilling machine which is provided with a table, allowing the fixture to be moved from one spindle to the other. These heads each carry eight drills which drill the holes for the ring gear and the other half of case.

After counterboring and tapping, oil grooves are milled at four points across the inner face as shown at *A*, Fig. 7. This is done on a Whitney hand milling machine with a small end mill. The stop screws, as at *B*, position the table so as to insure the proper depth of groove, and the side movement is also limited by suitable stops.

The two halves of the differential gear case are then



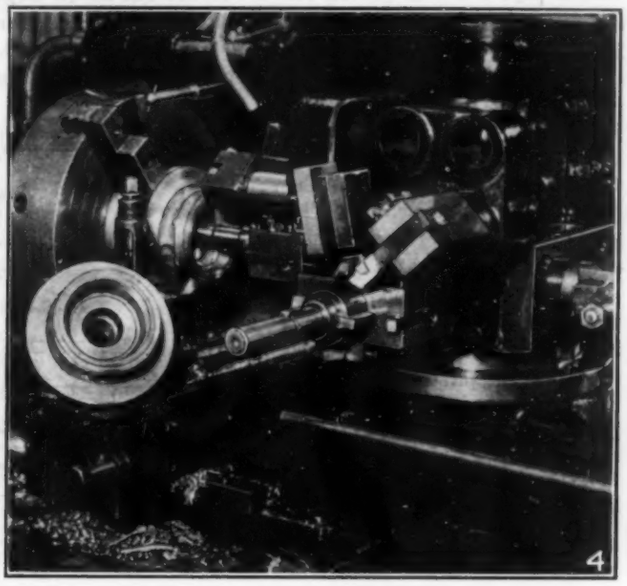
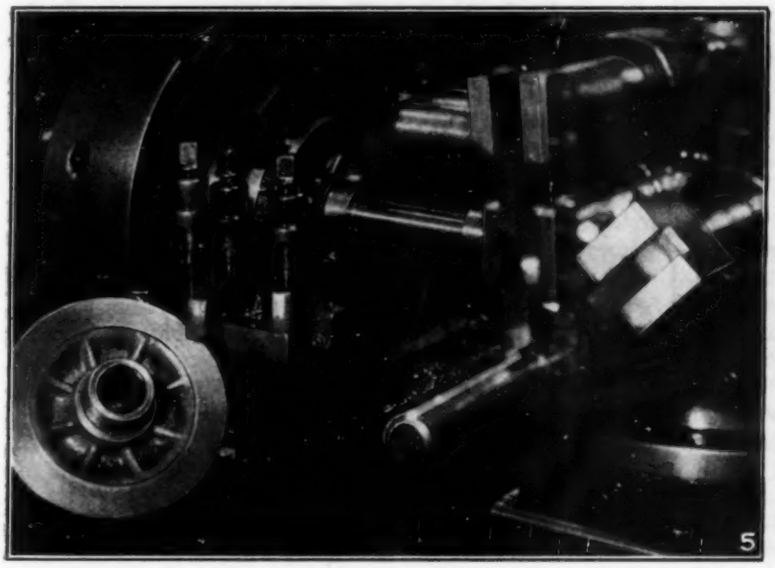


FIG. 3. BORING THE BEARINGS. FIG. 4. MACHINING THE INSIDE OF DIFFERENTIAL CASE



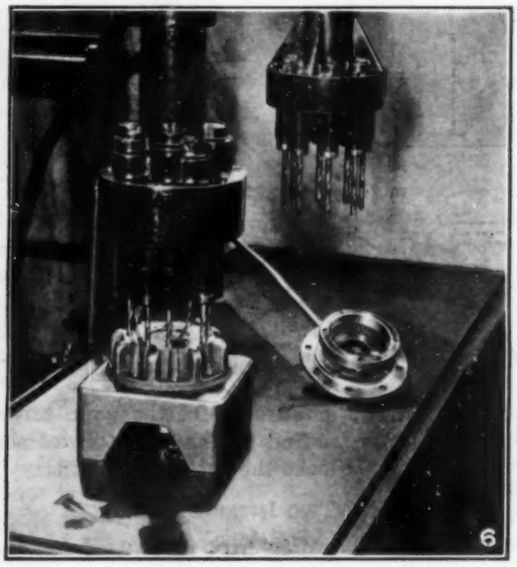


FIG. 5. THE SECOND OPERATION. FIG. 6. DRILLING THE TWO SETS OF HOLES

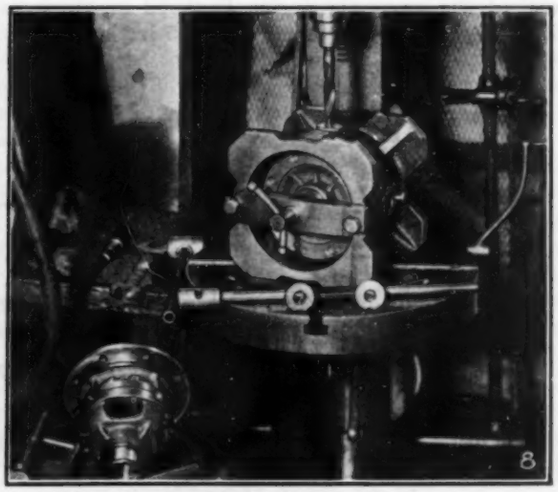


FIG. 7. MILLING OIL GROOVE IN FACE. FIG. 8. DRILLING CROSSHOLES FOR SPIDER

bolted together and placed in the fixture shown in Fig. 8. Here the four crossholes for the differential spider which carries the bevel pinions are drilled and reamed.

The tool for turning the ball in the gear case is shown in Fig. 9. This tool is held in the turret and a rack plunger *A* operates the sector around the pivot *B*, which moves the tool *F* in the proper arc. The plunger *A* is operated by the cross-slide.

The setting of the tool to the proper radius is gaged by the device shown in Fig. 10 in which the parts are lettered to correspond with Fig. 9. The yoke is located in the center of the pin *B* by means of the fixed cone points *C* and *D* and is set to the proper radius and when in place, as shown in the lower view, the

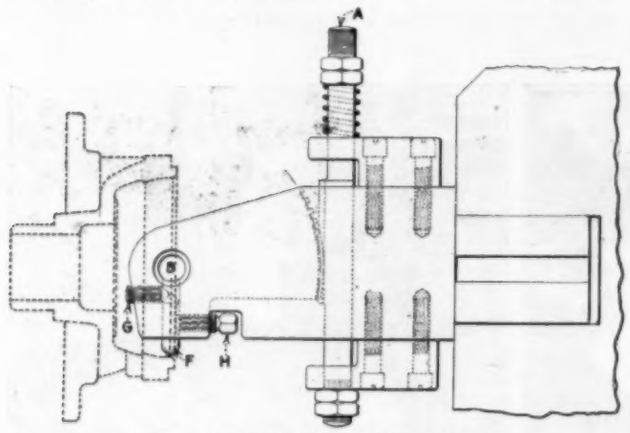


FIG. 9. RADIUS TURNING TOOL

cutter *F* is adjusted to meet the gage screw *E*. The adjustment is secured by the cone pointed screw *G* and the setscrew *H* locks the cutter in position.

Two Interesting Gages

The gage shown in Fig. 11 is used for checking the distance between faces *A*, *B*, *C*, *D* and *E* in the first operation. These faces must bear a definite relation to each other, within close working limits. At the "Go" end of the gage, the feeler *F*, 0.062 in. thick, is used. At *C* a grinding allowance of 0.005 in. is left for finish.

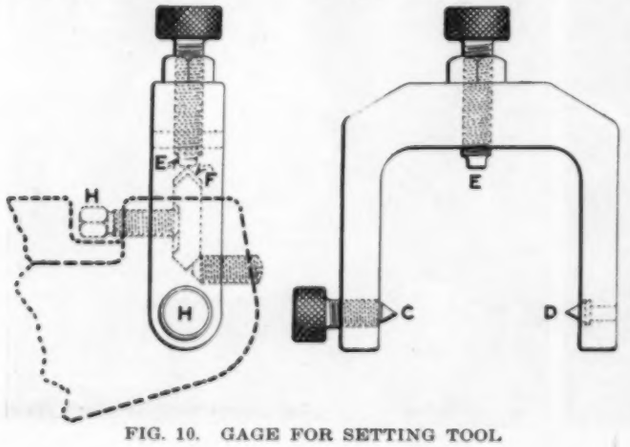


FIG. 10. GAGE FOR SETTING TOOL

The feeler *F* will pass the "Go" end of gage at *C* but will not pass the "No Go" at *D* by 0.002 in. The same is true of faces *B* and *E*, except that no allowance for grinding is made here. The faces *B* and *C* are held in close relation with *A* on account of the cross pin drilling operation in which *C* is used as a working face.

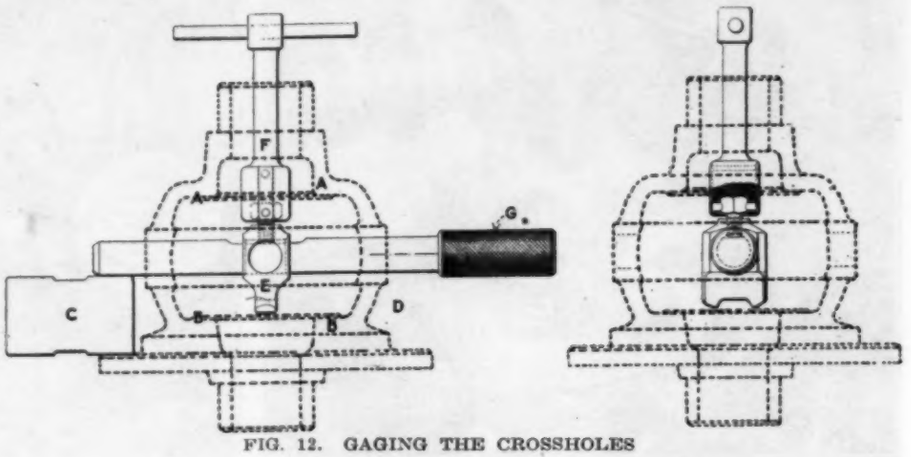


FIG. 12. GAGING THE CROSSHOLES

Another interesting gage which is used on the final inspection is shown in Fig. 12. The two halves of the case are bolted together, as shown by the outline. The screw of the rider *E* is slipped into the socket wrench *F* which holds it by means of a ball retainer. The rider

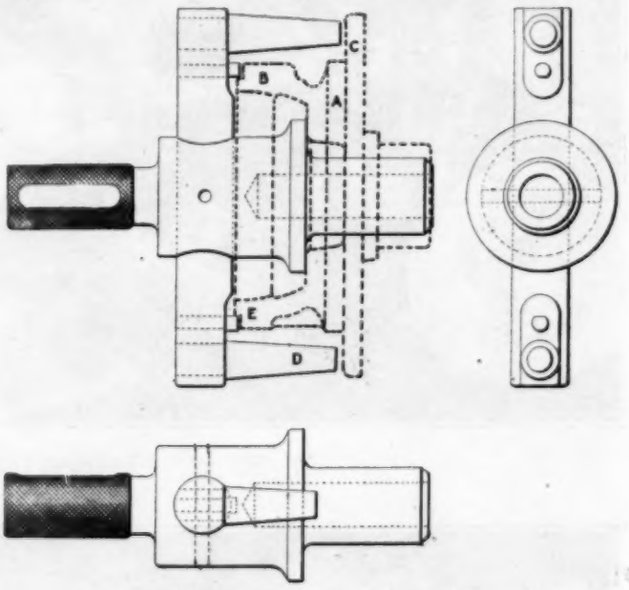
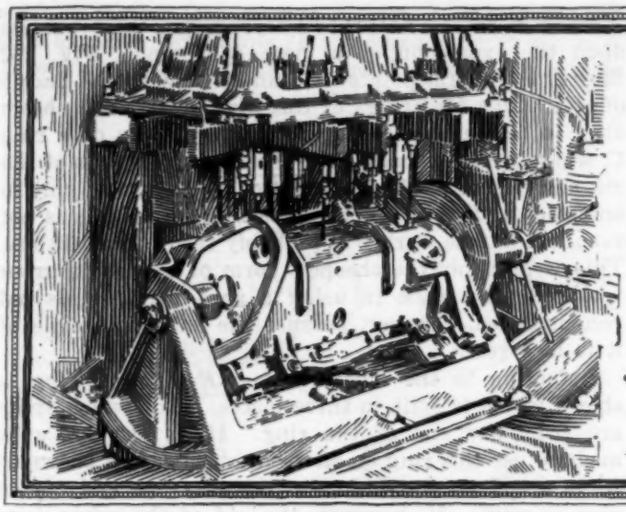


FIG. 11. GAGE FOR THICKNESS OF CASE

is then placed in the center-hole and the bar *G* passed through the holes for the spider and through the rider *E*.

The rider is then fastened to the bar by its screw and the wrench removed. The bar *G* is then moved both to the right and to the left. By swinging the bar, both the "Go" and "No Go" ends of the rider are brought over the surfaces *B B* testing their relation to the cross-holes. In a similar way the surfaces *A A* are tested by simply swinging the rider up to contact with these points.

By using a "Go" and "No Go" distance gage at *C* and *D*, the relation of the holes to the flange is also tested at the same time. This gage is very complete and can be modified for various uses in other lines of work.



Tool Engineering

By

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Work-Holding Fixtures for Lathes Concluded—Second-Operation, Inside-Holding Methods—Various Types of Expanding Arbors—Design of Taper, Split-Ring and Expanding-Pin Arbors

A COMMON form of expanding arbor is illustrated in Fig. 279, the work *A* being held on the cylindrical portion of the arbor *B*, the taper end of which fits the spindle of the machine. The cylindrical portion C is split with saw cuts in three or more places so that it can be expanded on the end to hold the work. In the example shown, the expansion is done by means of a pull-back rod *D*, which has a taper end *E* fitting the taper portion of the arbor. In order to make it spring properly, the end is relieved by a recess as shown at *F*. This type of arbor really expands only on the extreme end; and, although for a great variety of work this action is sufficient to hold the piece, there is considerable likelihood of its running out of true after it has been in use for a while. This trouble can be avoided to some extent by a construction similar to that shown, in which the plug that centers the jaws and expands them has bearings at *G* and *H* which tend to keep it true. If the plug is true, the arbor itself will be accurate.

Another method of expanding the same general type of arbor is shown at *K*. In this case the arbor and expanding plug are self-contained, and the plug is tightened by means of a wrench at *L*. When this type of arbor is designed care must be taken to make the cylindrical bearing *M* long enough, so that it will assist in keeping the plug true and central. It is usually necessary to make the threaded portion a rather free fit, in order that there may be no cramp in the operation.

The two arbors mentioned are both designed to be used in the spindle of the machine, but it sometimes is necessary to provide an additional support, particularly when work is a little longer than normal. The example at *O* illustrates a method which can be used in cases of this kind. The arbor *P* is very similar to those previously shown. The plug *Q* is quite long and has a long bearing at *R* in the arbor itself. The end of the plug, which is squared up to receive a wrench, is so made that it has a countersunk hole in it to receive the center *R*. The extra support provided by this center enables the operator to take heavier cuts on the work.

In Fig. 280 are shown several illustrations of special arbors of the expanding type. The work shown at *A* illustrates a principle in arbors of this kind which is all right; but its application to the work shown is very bad indeed, on account of the lack of support which the work and the end of the arbor receive. It might be possible to use this same arbor with a center support and obtain good results from it, but its application as it is shown is not to be recommended. Several points in the construction are worthy of note. The arbor *B* screws into the nosepiece *C* and fits a tapered portion *D*, which centers it accurately. The end of the arbor is split in three places at *E*, and is expanded by means of a taper plug *F* operated by the collet mechanism on the machine. The general construction of the arbor and the method of operation are excellent.

An unusual type of expanding arbor is shown in holding the work *G*, which is a long shell of metal that has been rough-bored on the inside surface *H*. It is to be finished on the outside and the end in this operation. The body of the arbor *K* fits and is fastened to an adapter shown by the dotted lines. This arbor is ground on the outside *L* and fitted with a series of hardened rings *M*, which are chamfered to receive the hardened and tempered spring rings *N*. The operation of the device is by means of the rod *O* which pulls back on the collar *P*, thus tending to force the spring rings out against the inside of the casting, and gripping it securely. The rod *O* is operated by the collet mechanism. In order to locate the work properly two stop pins are provided at *Q*. It is necessary to support the outer end of the work by means of a center point, as shown by the dotted lines.

Another example of an expanding arbor is shown at *R*, the work in this instance being a hub which has been previously bored at *S* and finished at this end of the casting. The work locates on the portion *S*, and the other end of the arbor is arranged so that it will expand and grip the inside of the portion *T*. The plug used is similar to one shown previously, but it is so arranged that shell tools can be piloted on the portion *U* for machining the inside surface *V*. A center is used to support the end of the arbor.

The designing of split spring-arbors must be done with care, particularly as regards the proportioning of the material about the parts which are to be expanded.

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In order to bring out the principles involved, two exaggerated examples are shown in Fig. 281. In one of these the section through *X–X* is too heavy, while in the

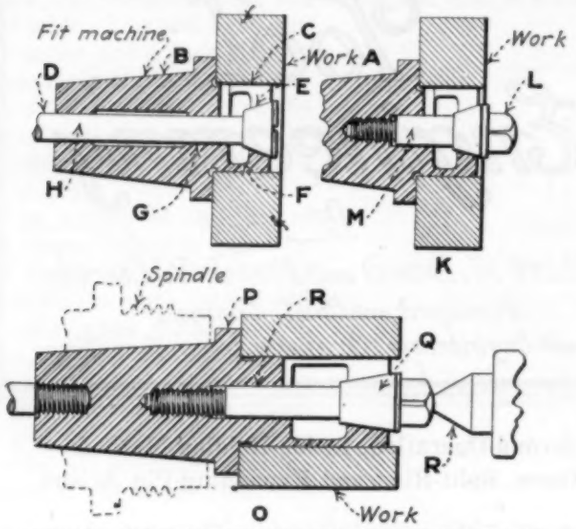


FIG. 279. ARBORS EXPANDED BY TAPER PLUGS

other example the section through *Y–Y* is too light. In considering the matter, it must be remembered that the closer the design approaches a hinge construction the more successful the arbor will be, yet at the same time this matter must not be carried to extremes as in the case *Y*, because an extremely thin section might be cracked and ruined in hardening. There must be metal enough to withstand the heat and sudden cooling when the arbor is hardened and tempered.

It is customary to drill some fairly large holes at the end of the slot, as indicated at *A* and *B*, to assist in permitting spring to the jaws. Care must be taken also to avoid sharp corners around the hinged point, as they would be likely to cause cracks in hardening or fracture in use. Large fillets like that shown at *C* and *D* are a decided advantage in the design. Extra precautions should be taken in regard to these points if a successful arbor is to be made.

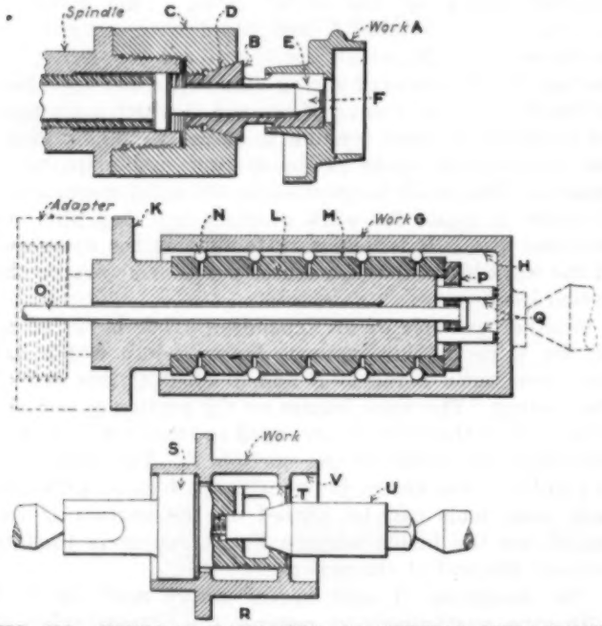


FIG. 280. SEVERAL VARIETIES OF SPECIAL EXPANDING ARBORS

Many varieties of arbors depend for their success upon the expansion of a loose split ring. Fig. 282 illustrates several points in connection with the design of split rings for arbors of this kind. The work shown at *A* is held on a tapered arbor *B* by means of a ring *C*, which is drawn back on to the taper by means of the nut and washer at *D*. This particular ring is cut only in one place at *E*. As a consequence, the expansion is not even and untrue work will probably result from its use. This is probably the cheapest form of expansion arbor which can be made in using a split ring. It is not recommended, however, because the entire principle of it is incorrect.

Referring to the illustration at *F*, another ring is shown which is split in three places, all of which splits are from one end of the ring. If an attempt were made to use this ring on an arbor such as that shown at *B*, it would not expand at all because one end of the ring is solid. If, however, the end of the arbor were to be relieved a trifle so that the bushing would not bear at this point, there would be a certain amount of expansion, but it would be all at one end of the bushing. The proper way to make a split ring is like that shown at *G*, where the ring is cut by three slots from each end, which permits it to expand equally all over. In making up a ring of this sort the toolmaker commonly leaves a "tie" of metal at the end of each slot, as indicated at *H*. This "tie" is left in during all the operations on the work. After grinding, however, a thin wheel is used to cut it out, thus permitting the ring to expand. This method assists greatly in the various operations, as the work is not so difficult to hold true. Fig. 283 shows two very good examples of arbors in which the split-ring principle is used. The work *A* locates against a shoulder on the piece *B*, which in held in the nosepiece *C*. The ring *D* is split at both ends in three places with saw-cuts running nearly up to the center of the bushing *E*. A draw rod *F* runs through the center of the arbor and is provided with a taper end at *G*, which is supported by the center shown at *H*. In operation, the draw rod is pulled back, thus expanding the ring at *G* and at the same time pulling it back until it rides on the taper at *D*, which causes this end to expand, thus gripping the work firmly at both ends. In the design of an arbor of this sort, care must be taken to make the taper on *G* slightly larger than that at *D*, in order that sufficient pulling action will be exerted in addition to the expanding, so that the end *D* will be carried back and expanded.

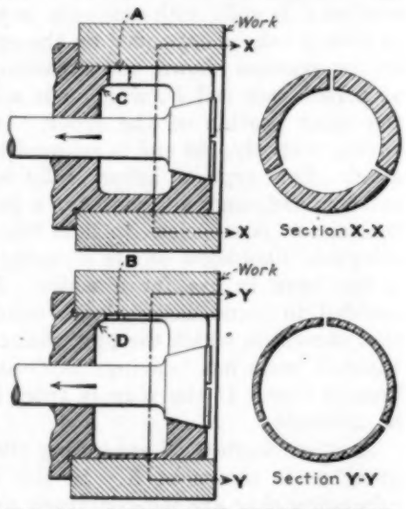


FIG. 281. DESIGN OF SPLIT SPRING-ARBORS

A somewhat similar arrangement is shown for the work *K*, which arbor, however, is of much heavier construction than the other. The nosepiece *L* is fitted with a sleeve *M* having a taper at *N*. The bushing *O* is

made in similar form to that previously mentioned, and it is expanded by means of a tapered plug *P* which is drawn back by means of the rod *Q*. In this case also

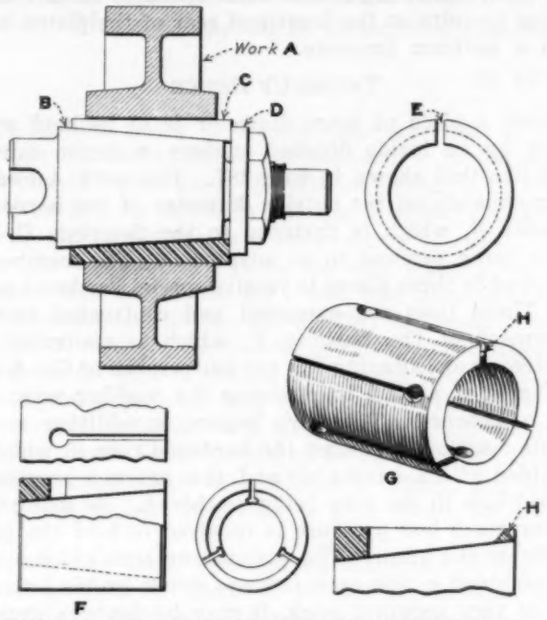


FIG. 282. USE OF SPLIT RINGS IN ARBOR DESIGN

the taper *P* should be more obtuse than that at *N*, in order to provide equal expansion on both ends of the bushing. The screws *R* and *S* simply act as retainers to hold the bushing in place.

Expanding Arbors

In Fig. 284 are shown two arbors of special design and used for long work. In one example, the work *A* is located on a hardened ring *B* at one end of the arbor, a stop being provided for the inside of the work at *C*. The other end of the arbor is tapered at *D*, and at this end a spring expanding ring *E* is located. This ring is split in three places and has a spring wire ring *F* to hold it together. The other end of the bushing has a shoulder on it, as indicated at *G*. A threaded collar *H* is provided with a supplementary ring *K*, which grips the shoulder at *G* and pulls the split ring back over the taper portion of the arbor, thus expanding it

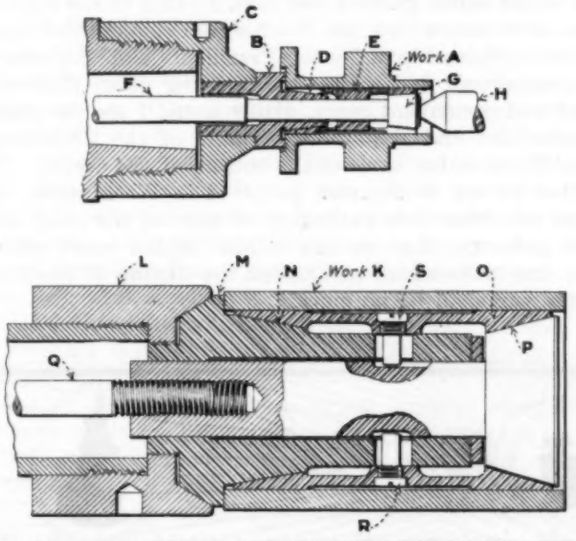


FIG. 283. TWO SPECIAL ARBORS WITH EXPANDING SPLIT RINGS

until it grips the inside of the work. A fiber disk is interposed between the shoulder of the collet and the sleeve *K*. To assist in placing the work on the arbor a tapered ring is provided at *L*. One end of the arbor at *M* is held on centers and "dogged." The other end receives its support from the work itself which has a countersunk portion *N*, in which the tailstock center is placed.

Another arbor for long work is shown at *O*. This example consists of a center member *P* tapered at *Q* to fit the inside of the sleeve *R*. The other end of this sleeve has a tapered portion *S*, on which a spring sleeve *T* is located. The nuts at *U* and *V* are used to expand the two sleeves *T* and *R*. This design can be considerably improved by simply threading the end of the arbor *P* and carrying the nut *U* over in such a way that it would bear against the end of the bushing *T*. If this were done, one screw would be sufficient to tighten both members, and the equalizing action would doubtless be better than in the construction shown.

The use of compressed air as a medium for operating expanding arbors on chucks has a number of advantages, as the amount of pressure can be easily controlled and equalizing action determined with certainty. Many of the devices previously illustrated can be operated by means of compressed air if desired. The application is simple, and the installation can be easily made to conform to the conditions. Fig. 285 shows an expand-

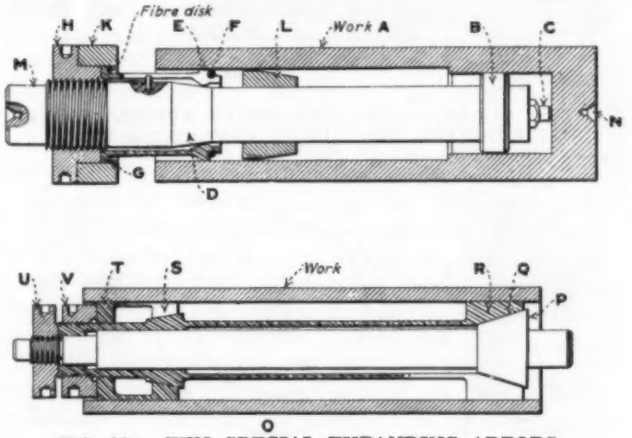


FIG. 284. TWO SPECIAL EXPANDING ARBORS

ing arbor intended to be operated by compressed air. The work *A* rests against the hardened ring *B* on the nosepiece *C*. There are eight pins *D*, four of which are at one end and four at the other end of the arbor. These pins are held in position against the taper sleeves at *E* and *F* by means of coil springs. The sleeve *F* is attached to the member *G*, which is hollow. The other taper piece *E* is operated by the bar *H*, which passes back through the spindle and is fitted with a piston against which the air operates. The sleeve *G* also has a piston, and between these two pistons the air pressure is exerted. As the air is turned on, the sleeve *F* moves forward and the sleeve *E* backward, the action being nicely equalized by the pressure of the air. The releasing of the arbor is easily accomplished by a reversal of the motions mentioned. A device of this kind can be operated mechanically if desired, by means of a right- and left-hand thread and a suitable handwheel at the end of the spindle. The principle shown here can be applied to many kinds of work, both rough and finished.

Another type of arbor having a series of equalizing

expanding pins; and frequently used for the holding of automobile pistons is shown in Fig. 286. This chuck can be operated either by means of air or by a handwheel at the rear of the machine. The work *A* is held by means of three pins *B* at one end, while at the other end two pins are used, both of which may be like that shown at *C*. If the construction of the piston is such that there is very little room at this end, it is even possible to use pins like those shown at *D*. Another arrangement can also be made by using three pins at the forward end of the piston, and placing two of these

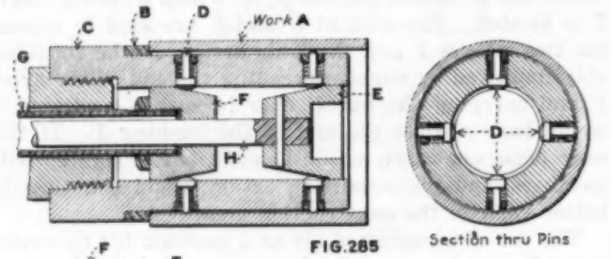


FIG.285

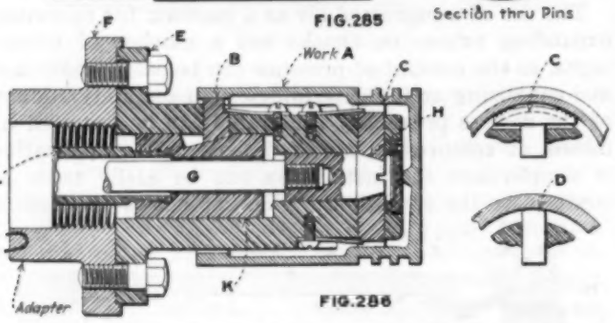


FIG.286

FIG. 285. AIR-OPERATED EXPANDING ARBOR. FIG. 286. ARBOR WITH EQUALIZING EXPANDING PINS

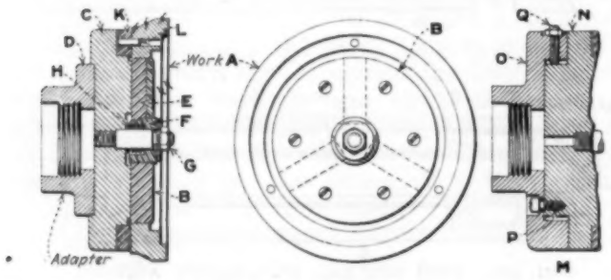


FIG 287. EXPANDING ARBOR WITH PROVISION FOR TRUING-UP

pins at a suitable angle, as determined by the amount of space available.

The body of the arbor *E* is fitted to an adapter *F* to which it is bolted, as shown. A rod *G* extends through the spindle of the machine and is used to operate the angular member *H*, which controls the movement of the forward pins. A bushing *K* controls the movement of the pins *B*, the operation being accomplished by its connection with the sleeve *L*. If the rod extends through the spindle and is shouldered at the other end, and if the sleeve *L* is threaded so that it fits the inside of a handwheel, a few revolutions of the latter will serve to expand and contract the pins readily. There is a very good equalizing action when operated in this way, so that the pins at the front and rear of the piston bear with a uniform pressure.

Truing-Up Device

When a piece of large diameter is to be held accurately by an inside finished surface, a device can be used like that shown in Fig. 287. The work *A* locates approximately on the outside diameter of the hardened member *B*, which is fastened to the faceplate *C*, the latter being screwed to an adapter *D*. The member *B* is slotted in three places to receive special hardened jaws *E*. These jaws are expanded and contracted by the movement of the bushing *F*, which is controlled by tightening or loosening the nut and washer at *G*. A coil spring at *H* assists in releasing the bushing when the nut is loosened. The work locates, in addition to the points mentioned, against the hardened ring *K*, which is provided with a driving pin at *L* that enters a previously drilled hole in the ring being machined. By using this driver much less pressure is required to hold the piece firmly on the arbor. The various surfaces which are to be machined in this operation are shown by the *f* marks.

For very accurate work, it may be found a decided advantage to arrange arbors of this or other kinds in such a way that they can be trued up from time to time, if they should become slightly inaccurate. A method of making provision for this contingency is shown at *M*. The faceplate *N* is mounted on the adapter *O*, and held back by means of several screws *P*. It is also centered on the faceplate by other screws *Q* around the outside of the adapter. When it is necessary to true up the device, all these screws can be slightly loosened and adjustments made, so that the important points will run absolutely true. After testing with an indicator and making sure of the truth of the arbor, the various screws can be tightened, and the arbor is ready for work.

Schwab Speaks on Disarmament

Charles M. Schwab, at the dinner given to Marshal Foch by the American Iron and Steel Institute, said:

"I say to you from the bottom of my heart—and no one would suffer greater loss than I—that if the statesmen now assembled in Washington under the far-sighted leadership of our President and Secretary Hughes should find it possible to bring about disarmament and permanent peace, gladly would I see the great ammunition and shipbuilding plants of the Bethlehem Steel Corporation sunk to the bottom of the ocean.

"Let us say to the men gathered in Washington, let it go out from this gathering of men of the steel and iron industry, that we are solidly behind every effort they can make which will hasten the coming of the time when war shall be no more."

General Stagnation of Russian Manufacture

Russians Returned from America Fail as Model Workmen—Locomotive Repair Inefficient—Money Wasted in Ordering Locomotives—Brief Histories of Specific Plants

By ROYAL R. KEELY

BEFORE going to Russia, Martens, then in New York, had approved Lomonossoff's invitation to me to visit Russia. Therefore I thought he might aid in getting me out of prison, and I wrote him several letters, but he did not have the courtesy to reply. Consequently I would not go to see him when I was released. One day, however, I met him accidentally on the street and he made a great effort to appear cordial, and asked why I was "working" in a small Russian-American factory. I replied that it was not my choice; that I was a prisoner and obliged to work where the government ordered. He told me that my abilities could be much better employed in the central office of the Supreme Council of National Economy, and asked me to call on him to discuss a plan which he had in mind.

A few days later, I visited his office and he outlined at some length his plan for conducting Russian emigrants from America. He said the experiment of having emigrants back from America had been successful and that he was organizing a department of American-Russian emigrants. He proposed to select certain factories to be set aside exclusively for employing them, the factories to be supplied with all necessary materials. His idea was that the returned emigrants would be fresh, with the American spirit and the American skill in efficiency and mass production. The plants would be the model and inspiration for other plants, and thus Bolshevik industries would be saved and the economic crisis passed.

Russians Returning from America Have Failed

As I have already stated former professors, engineers, factory managers, railroad directors—able, honest and energetic men—were occupying themselves with electrification schemes (electric plows, electric transmission of power from the coal fields, etc.) plans for redistribution of the manufacturing industries according to an ideal plan, and in writing treatises on such subjects as the automatic coupler for railway cars and elaborately worked-out plans of standardization. They were impractical, visionary schemes, which for generations to come can be of no practical benefit to Russia. When the elaborate plan was made, the problem was 99 per cent solved and nobody worried about its realization in practical, every-day life. It was their work for the government and they could have some freedom in their theorizing, while if they had not been doing that, they would have been forced into some physical drudgery. It was just what Martens was doing in his plan for taking 100,000 Russian emigrants from America. It was an interesting theoretical toy which pleased the Bolsheviki and gave him some liberty.

I have heard that about 10,000 Russian emigrants have returned to Russia from America since the revolution—some because deported and some voluntarily. I am satisfied, from my own observations, that they are all unhappy under Bolshevism and are very sorry that they left America. I say "all"; that of course, is not strictly true. A few destructive agitators, too illiterate and indolent to earn a respectable living in the United States, are received by the Bolsheviki as heroes. In Russia they receive better houses, better food and better clothing than they ever had, and of course they are pleased, but their number is so small as to be negligible.

The Russian-American Instrument Co. attempted to take the emigrants into its factory, selecting the most promising. This arrangement failed, the company finding it better to take simple, untrained Russians—mostly women—and train them to operate machines and to do certain routine work.

In Petrograd, in February, 1920, I met a foreman of former days in the Arthur Koppel plant (England). In pre-revolutionary days, he had owned his own home and garden. At the time of my visit he was a member of the "Soviet" of the Koppel plant, and also member of the Petrograd "Soviet." He had not been disturbed in his little cottage. His wife kept house and raised the necessary vegetables for their year's keep. By energy and forethought, he secured wood for their winter's fuel during the spring and summer, when it was cheaper and easier to get. They were wearing their pre-revolutionary clothes and he complained that while he had it far better than the other men in his, and other Petrograd factories, he and his family lived only with the greatest difficulties and hardships.

His brother, who was a deportee from the United States, furnishes another typical example. The Koppel factory had, in the old days, owned its own restaurant which it operated at cost for the benefit of its force. Under the Soviet the restaurant was "nationalized" and operated by the Petrograd Central Food Department. The only food the employees got from the government was a noon lunch. The brother told me that, although he had been there over a month, and was hungry all the time, he was not able to eat the soup. He was mourning over the good life he had had in America, and his chief interest was in forming a plan of escape for himself and his brother. The former manager asked to have a meal served to me—the same that the men received—as a sample. When the soup was brought in he remarked to his companion, in Russian, "And still it is better than that served to the workmen." I tried to eat, but one wooden spoonful was all I could swallow of the soup made from bad fish, frozen potatoes and cabbage.

And so Martens' statement that the experiment of taking emigrants back to Russian factories had been successful—was absolutely false, and he must have known it at the time. He suggested that my "compulsory work" be the selection of certain factories for the 100,000 returning emigrants. Only by deception and fraud could he get them to come, and the result would be 300,000 (counting three to the family) disheartened, discouraged, miserable people. We had many discussions about whether or not I would accept work in his department but we came to no conclusions, and shortly afterwards I was enabled to leave Russia.

Nearly all the liquid wealth of Russia has been de-

stroyed. But, fortunately, the greatest wealth is in the farms, forests and minerals, which are still there waiting development. The great problem is to find a means of stopping the destruction and arriving at the stage where reconstruction can begin. Since my first acquaintance with Russia in the summer of 1919, this destruction has gone steadily on. Personally, I am convinced that the rate of destruction is now greater than ever before. That is not hard to understand. Since the revolution, there have been no exports. As to supplying the demands of greater Russia, the imports have been infinitesimal and have consisted of only such things as could be paid for cash in advance. The cash with which they are purchased was inherited from the old government, or has been stolen from the private fortunes of the Russian people. All of the wealth that was confiscated the leaders have spent in riotous living and in enriching themselves. Large quantities have gone for propaganda at home and abroad.

Shortly after the blockade was raised the Bolsheviki placed some rather large orders with German firms for railway material. Twenty-five per cent of the contract price was paid with the order. Most of the contracts have been canceled and the deposit lost. The reason is clear. A German locomotive builder took a contract of approximately $50,000,000 for the delivery of locomotives to Russia. With the 25 per cent deposit which he received he went to Hamburg, bought a private yacht and started on a tour around the world. He was convinced that the Bolsheviki could not and would not keep their contract, so he made no effort to build. Since then the price of locomotives has gone down about 50 per cent and the Bolsheviki have, as he expected, canceled the contract, for it is easier and cheaper for them to lose the 25 per cent deposit than to lose 50 per cent of the cost price. I know of several manufacturers who had a similar experience.

One is surprised by the almost complete absence of traffic from the railroads, both passenger and freight. The commerce of the nation is dead. All the business houses of the cities are closed except the very small ones that have opened recently. The pavements and sidewalks are in painfully bad repair. The buildings are constructed of cheap, soft, brick with bad mortar, plastered over the outside. Now that they have been neglected for six or seven years, the plaster is falling off and the moisture and frost are doing their destructive work. Roofs are leaking. Machinery and equipment are in bad repair and getting worse daily. And what is especially discouraging is that no one has any interest in anything but seizing as best he can the daily necessities. There is the feeling among all the people that the experiment must sooner or later fail and that anything they do to support a system which is fundamentally wrong, is worse than useless.

Consider the big Amo automobile factory in Moscow, built by private capital under special encouragement from the old government. It is a fine factory with a complete equipment of the finest American machinery. There the Bolsheviki have a fine chance to succeed in factory organization and production, except that Russia does not need automobiles as badly as it needs simple farm machinery, clothing, fuel and general household supplies. But Bolshevism will always waste much of its time on some fantastical whim, rather than on practical necessities.

For full operation, the factory would require about 6,000 men. At the time of my first acquaintance with it, it had about 1,000 men, but only two or three skilled mechanics. There was no raw material and very little fuel; little repair work was being done. The old government had bought a lot of White trucks for the war. As they were disabled they were sent to the factory, dismantled and the good parts assembled into good trucks again. After a while, however, they ran short of motor parts and had some ninety bodies without motors. They decided to build a motor, and worked all winter trying to get one good motor cylinder casting. They failed every time, partly because of lack of skill and partly because of absence of proper material. The manager at that time was a rather able Russian engineer, who was hindered by a management committee of ignorant workmen who had authority over him. He had no power to hire, discharge or discipline without their consent. Also, he was given conflicting orders from the automobile building department in Moscow, the automobile repair department, the food operating department, the army repair and operating departments. All his holidays were spent at hard physical work with a gang of men about the factory on the theory that all should be made to do some physical work.

I saw the same factory again in June of this year. It has about the same number of men but no sign of improvement. There is no basis on which to build—no fuel, no material, no trained workmen, no adequate transport. The new manager was threatening to quit if he didn't get a proper place to live and better food. The factory has never been entirely completed and no one knows enough of the requirements of automobile building to be able to complete it. There is no incentive to work and pay is independent of production.

The Bromly Brothers and International Harvester Company Plants

The Bromly Brothers factory in Moscow, founded by an Englishman, is also worthy of notice. It possessed good and modern manufacturing methods before the revolution and never stopped work during the revolution, therefore having a chance to retain its old working force. It is not surprising then that it is still one of the best. In the fall of 1919, the entire supply of wood fuel, collected during the summer, was confiscated by the war department. It is such methods that have absolutely killed all initiative and thrift. If anyone, by energy and care and foresight, provides for himself it is taken away and given to the shiftless, the careless and the indolent.

Another comparatively "good" plant in Russia is that of the International Harvester Co., near Moscow. It is the only plant of which I have heard that has not been "nationalized." Because of the Bolshevik control of the labor, the material, the fuel, the transport and the product, it is practically no better off than other factories. The chief difference is that the old management has succeeded in retaining some measure of control of the production. Their "Soviet" has meddled in housing, in food, in social affairs, health, etc., but the old manager has insisted that technical matters of plant operation belong strictly to the technical staff. The factory has a fine little hospital that the village tried to "nationalize," but the manager managed to save it for his employees, who appreciate it. Had it gone to the village it would have been destroyed in a few weeks and no one would have profited.

The factory had a locker and washroom with an individual steel locker for each man and neat enamel wash

basins with hot and cold water. The factory soviet began an agitation for individual wash basins as being more scientifically sanitary. This continued until the manager found a cure. One morning he stationed himself at the gate and grabbed each man who came in who had not washed since the previous day and said, "You did not wash last night." He found at least 75 per cent in that condition. After continuing such a shaming process for a few mornings the soviet dropped the individual basin fad.

All over Russia the oil, coke, coal and gas burning furnaces, as well as locomotives, have been converted for wood burning. In the International Harvester plant there was not room for the larger wood burning furnaces and the change would have completely upset the old arrangement and factory production system. The management insisted upon having coal and coke. Rikoff said, "We are unable to get coal and coke for you but we think you can get it for yourselves. We will give you trains and help and you can try. So in the spring of 1920 the manager's men made up a train and went south to the Donetz coal basin. It returned several weeks later with fuel enough to keep the furnaces running a few weeks longer.

One day I suggested to Lenin that better transport would mean better food and raw material; more food and material would mean better workmen; better workmen would mean better production; better production would mean better locomotives; and better locomotives would mean better transport; also that without better transport there could be no hope of industrial betterment, that better transport required better locomoives, and better locomotives again depended upon locomotive repair, so that the fundamental and first step in betterment should be locomotive repair. That, like "electrification" later, became a slogan of the administration. An order was issued that locomotives requiring repair should be taken into all factories, and that for every locomotive repaired the crew of workmen should receive a bonus in soviet cash and be permitted to take the locomotive for a trip into the country and bring food for themselves.

Repairing Locomotives Everywhere but in Locomotive Shops

As a result we had the strange spectacle of locomotive repairing shoved into all kinds of plants where previously there had been no spur tracks, no pits and no appropriate equipment or skilled workmen. At the same time, *all the locomotive building and repair plants of Russia were standing practically idle.* The order was that locomotive repairing should be taken only where it did not interfere with regular production. As there was no regular production worth mentioning, that was not a serious consideration, but if there had been it would have been destroyed by the upheaval. In sight of the bonus and the trip to the country, the locomotives got only "a lick and a promise" with the further advantage to the workers that they were soon back for a further bonus and another trip to the country. The proposal to take the locomotive repair into the International Harvester plant caused the manager and his superintendent three weeks of the hardest kind of fighting, for it would have destroyed the little nucleus he has preserved. He finally won. He used to say that the man won who could talk the longest, the fastest and the loudest. He used to laughingly remark that if his company ever returned it would fire him, saying, "We want work. You can do nothing but talk."

The production of the factory is painfully low. Fine large expensive automatic machines developed in the United States were standing idle for the want of competent workmen. Russian workmen cannot read drawings, therefore models have to be maintained for the worker. The workmen used to complain that they must work for wages only while in neighbor plants they drew wages and also attended to personal affairs. His workmen and foremen were constantly asking him for permits to leave. At first he granted their requests (it must be remembered that one cannot quit his job in Russia without an official permit); but then he saw that they were not bettering themselves, so he decided not to grant their discharges.

I dwell at length on the International Harvester factory for conditions were such that if, anywhere in Russia, success or production were possible, it was there. It only proves that factory production and success under Bolshevism are unthinkable and impossible at present.

An Example of Bolshevik Factory Management

Another factory that deserves attention is the Russian-American Instrument Co., looked upon as one of the most successful factories in Russia and pointed out with pride by the Bolsheviki as an example of what they can do in factory management. The driving force behind this factory is a group of mechanics who some years ago emigrated to America. There they learned American methods and organized a co-operative factory for toolmaking. They were in America during the war, were making $50, $60 and even $75 per week. Many of them had American wives. This co-operative group of sixty mechanics returned to Russia in 1918 because of patriotic motives. After many delays they found an idle spinning mill in Moscow. They took the spinning machinery out of the new concrete building and installed their American toolmaking machinery, completing the work in the fall of 1919. They were two years getting their little factory running, and beginning the production of taps, dies, reamers, drills, etc. But their difficulties were very great. To secure shafting, hangers, pulleys, belts, nails, screws, etc., required much time. Their difficulties are explained by the old story of material, food, fuel, transport, etc. The raw stock was from the old pre-revolutionary days, picked up from all over Russia. The quality was bad. They tried to increase their working force by taking some of the new Russian emigrants from America, but that proved a failure so they trained simple workers, many of them women, to operate machines which they themselves set up and tooled. In July of this year, they had a working force of about 350 persons. Each received a pound and one-half of bread daily which was more then employees in other factories got. At noon they got a little soup served at the factory. Once a month they got some vegetables and meat for home use. The sixty toolmakers made the highest wages, but none of them could live on the wages and food they received from the government. Each week they were selling clothing brought with them from America, safety razors and personal things to obtain the bare necessities in food. The shoes and clothing they were selling they would need badly in the coming winter, but they said they dared not think of the winter or of the future. They could consider only their present hunger.

Railroad Shop Operations and Apparatus

A "Home-Made" Acetylene Gas Generator—Cutting Continuous Threads on Stay-Bolts—Chucking Odd-Shaped Pieces—Systematic Arrangement of Tools

BY FRANK A. STANLEY

THE halftone and line engravings herewith illustrate a variety of tools and methods applied to the handling of work in various departments of the Southern Pacific Railroad shop at Sacramento, Cal.

The jigs illustrated in Fig. 1 are used for drilling the holes in draw bar yokes, two types of which are shown in Fig. 2. It will be seen from the latter drawing that in the case of yokes of the type shown at *A*, there are four holes to be drilled in each arm, while in yoke *B* there are only three of these holes to be drilled.

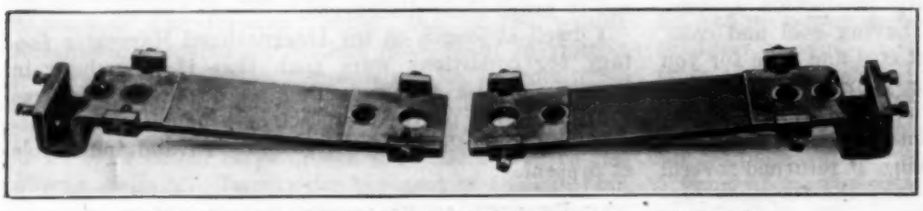


FIG. 1. JIGS FOR DRILLING HOLES IN DRAW-BAR YOKES

The jigs are made right and left hand, as shown in Fig. 1, each being in the form of a plate with one end offset to form a channel which permits that end to be placed over the end of the draw-bar yoke. The jig is then secured to the work by means of two screws tapped horizontally through the end of the jig plate. There are four lugs at the sides of the jig which are provided with screws for determining the side position of the jig on the work.

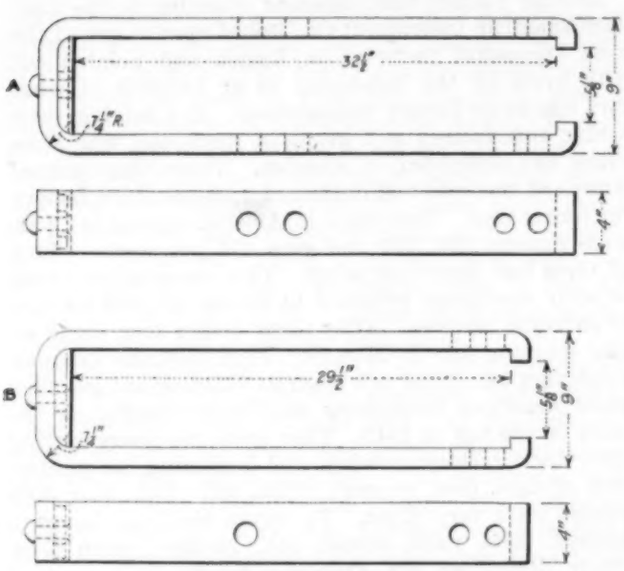


FIG. 2. DRAW-BAR YOKES

The halftone, Fig. 3, illustrates an attachment for the bolt cutter, with gages for cutting continuous threads on staybolts. The special jaws for holding the work are made as shown, with provision for end adjustment so that when a gage is placed in the jaws, the latter may be set properly to bring the opposite end of the continuous thread into the chasers in correct position, thus enabling the staybolt to be threaded properly when it is gripped in the jaws in place of the gage.

An Acetylene Generator

The halftone, Fig. 4, and the line drawing, Fig. 5, show a portable generator for acetylene welding operations. Fig. 6 illustrates the method of welding a cracked yoke under a locomotive by means of the acetylene torch. The generator, Figs. 4 and 5, may be made of a Pintsch tank or any other tank of suitable shape that will hold a pressure of 50 lb. In generating gas the pressure should not exceed 12 lb. per square inch.

On top of the generator there is a reservoir which is used for holding the carbide, which is fed into the lower tank as wanted, by a screw which fits the inside of the 2-in. pipe. The generating tank should be kept about half full of water as should also the washer cylinder at the end. The amount of water in each tank can be determined by the use of pet cocks. The filter cylinder should be filled with hair. The gas from the generator enters the bottom of the washer cylinder, comes out of the top and enters the bottom of the filter cylinder. The connection to the hose for supplying gas is at the top of this cylinder. The main tank should be washed out once a day. Care should be taken to keep the carbide dry until it is used for making gas.

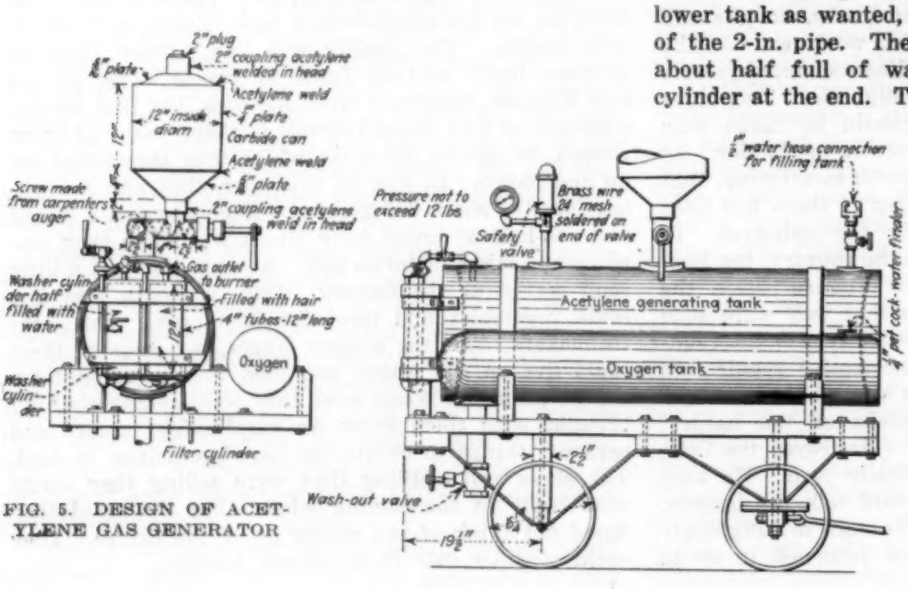


FIG. 5. DESIGN OF ACETYLENE GAS GENERATOR

The piece of brass .work

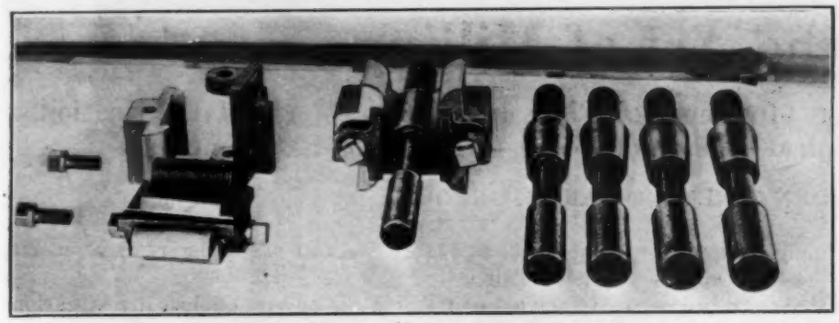


FIG. 3. BOLT CUTTER ATTACHMENT

shown in Fig. 7 is held in the two chuck jaws on the lathe by means of adaptors which are dovetailed into the jaw faces. These project from the jaws proper and form an adequate support for the brass casting that is to be machined. The special jaw faces also carry locating hubs upon which the work is placed so that its position is properly established when the jaws are closed, the work being thus held securely during the machining including the work on both of the opposite faces.

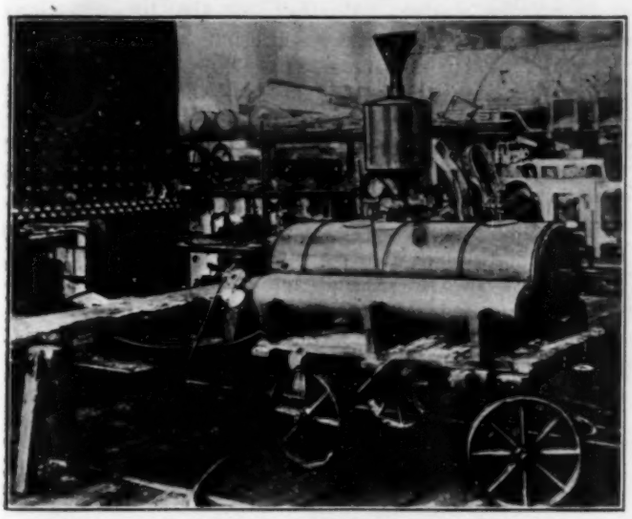


FIG. 4. PORTABLE ACETYLENE GENERATOR

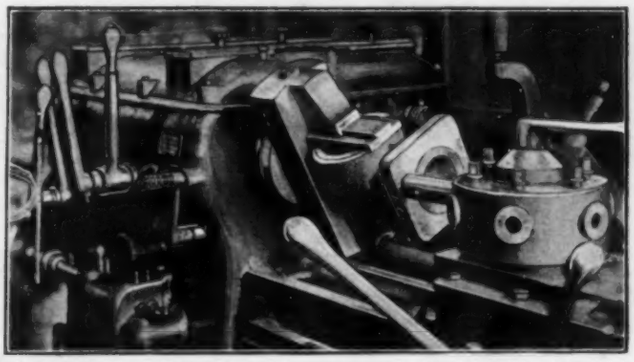


FIG. 7. HOLDING A PIECE IN THE BRASS LATHE

The drawer in Fig. 8 enables a large number of special brass-working tools to be conveniently stored. This type of drawer is used in cabinets and under the regular shop benches, it being arranged to carry a large number of tools which are kept within easy reach and can be readily selected when required for the job in hand. The false bottom of this drawer is provided with openings bored to suitable size for the tool shanks so that the tools stand upright as shown.

Other types of toolholding blocks are shown in Fig. 9. These are kept in a drawer or cabinet according to the requirements of the department where they are to be used. Flat cutters and tools of the character illustrated are awkward to store unless placed upright as indicated. In this position the maximum number of tools may be carried in limited space without danger of the edges injuring each other.

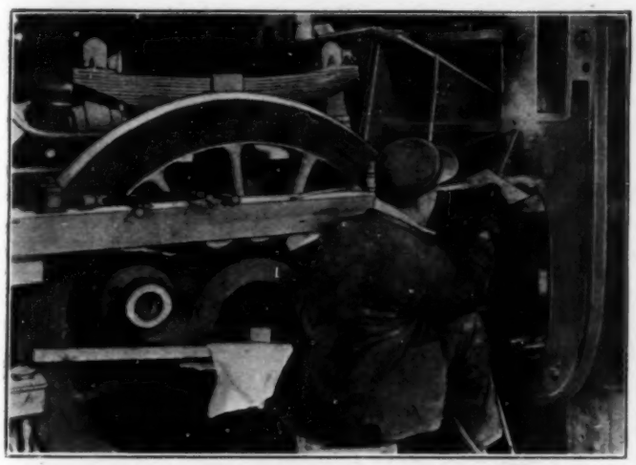


FIG. 6. WELDING A CRACKED YOKE

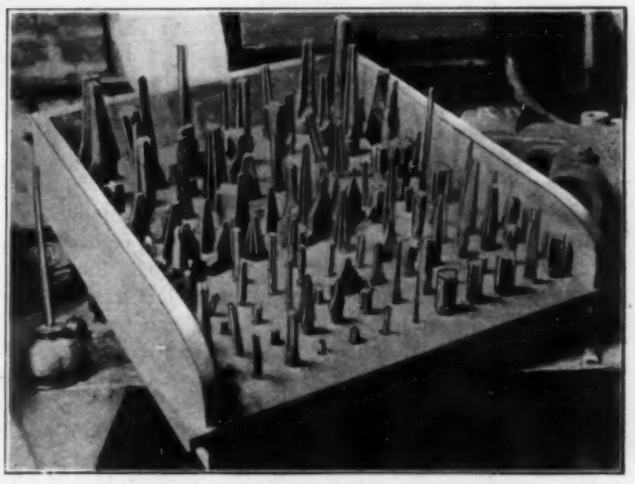


FIG. 8. DRAWER-RACK FOR TOOLS

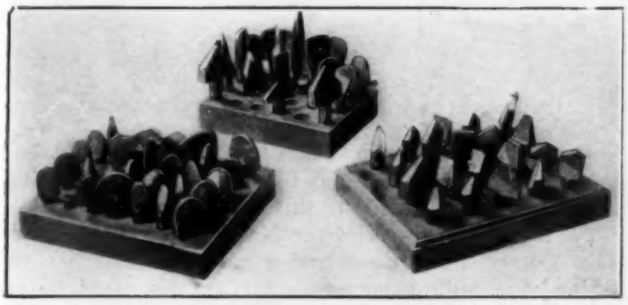


FIG. 9. BLOCKS FOR HOLDING TOOLS

On the Art of Milling

Studies of Single Tooth Action—Influence of Rake and Feed—Effects of Lubrication, Chatter, Clearance, Spiral—Shape of Tooth—Records of Experiments

By JOHN AIREY and CARL J. OXFORD

THE industrial value of scientific analysis applied to basic shop processes appears to be little appreciated when that analysis is contrasted with investigations carried on to improve the design of the manufactured product. This is explained partly by

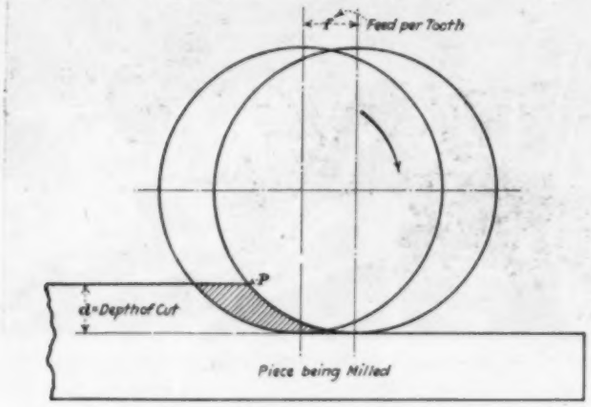


FIG. 1. SHAPE OF MILLING CHIP

the cleavage between the engineering department and the operating department in almost all plants. It is also partially explained by shrinkage in the significance of the term "engineering" until it means "design" only, when used in a quantity production atmosphere. This is either the cause or the effect of our engineering schools keeping out of touch with production proper and, consequently, research energy is lavished on all features of design, each minor side issue usually having its full quota of devotees.

In contrast to this, research endeavor covering basic shop processes appears to be badly neglected. Taylor, in this country, and Nicolson, in England, have done classical work in the field of lathe tool action. There is much to be done and many fundamental shop processes are yet untouched. A plea is here made that our engineering schools devote the same intensity of attention to shop processes that they now devote to design topics. The economic results to industry would be greater though not so spectacular. If a hole can be drilled more quickly or a surface can be milled more rapidly, then the cost of practically all classes of finished products is affected. This is true of improvements in all basic shop processes, whereas improvements in design benefit only a limited field—just one class of finished product. The economy accruing from improvements in shop processes being distributed over a larger territory makes it less spectacular and this, indirectly, might account for the decreased attention given it.

The practice of milling has, during the present century and the last decade of the nineteenth century, encroached decidedly on the field occupied by the shaper and planer. The action of milling possesses advantages over shaping; it also has its drawbacks. Much work must be done before we can state the relative merits or potentialities.

In the art of milling, the only published investigations have been handled by machine tool builders. Attention has in consequence been focused more on the machine than on the cutter. Further, in the investigations already made, the objects sought have usually had the defect of being too immediate. This paper describes an attempt to investigate the fundamental principles underlying the action of milling.

It is shown in the present investigation that metal is removed more efficiently with thick chips than with thin chips. It follows from this that, other conditions being equal, including speed and feed per minute, the cutter with the fewest teeth gives the greatest efficiency. However, it is evident that the efficiencies of two cutters with different numbers of teeth are equal provided the table feeds be adjusted so that the same feed per tooth is effected. This gives a definite working theory on the influence of spacing.

In addition to the present investigation, experiments published in substantiation of the advantage of wide spacing agree in confirming this theory. It is definitely established that for a given material, tooth shape and sharpness, thickness of chip is the sole criterion of the efficiency with which metal is removed in milling and that increase of spacing over that required for free cutting is a handicap. Present-day high powered cutters have several times the chip-space needed. Limitation of machine power has doubtless been the chief factor in giving a false bias to the influence of spacing.

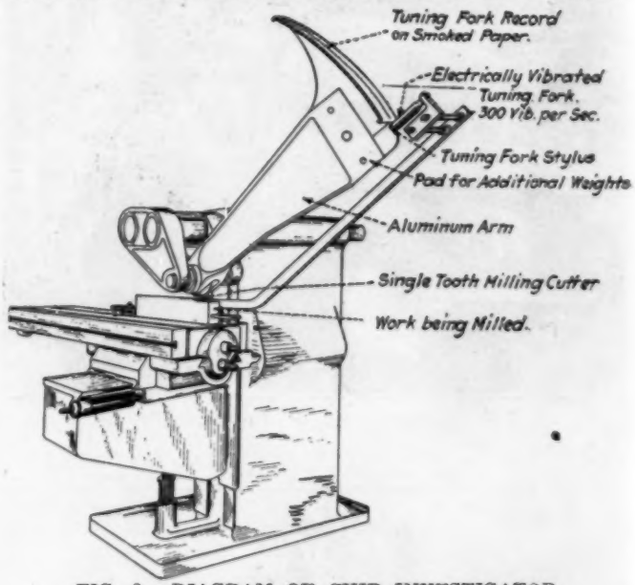

Tuning Fork Record on Smoked Paper.
Electrically Vibrated Tuning Fork. 300 Vib. per Sec.
Tuning Fork Stylus
Pad for Additional Weights
Aluminum Arm
Single Tooth Milling Cutter
Work being Milled.

FIG. 2. DIAGRAM OF CHIP INVESTIGATOR

The work described in this paper started in May, 1920, through a desire of the National Twist Drill and Tool Co. of Detroit, to find a rational basis for the action of a milling cutter so far as this could be removed from the region of empiricism. This company

Presented at the annual meeting, Dec. 5 to 9, 1921, of the American Society of Mechanical Engineers.

furnished the financial support throughout. The experiments have been conducted in the engineering shops of the University of Michigan, at the National Twist Drill and Tool Co., the Lincoln Motor Co. and the Hudson Motor Car Co. The greater part of the work was done at the University of Michigan, viz., all experiments on chip investigator and on the thrust and torque measurer. The work on the machineability tester was done at the National Twist Drill and Tool Co. and the tests on endurance were run at the two automobile plants.

The writers take this opportunity to express their appreciation of the encouragement given throughout by

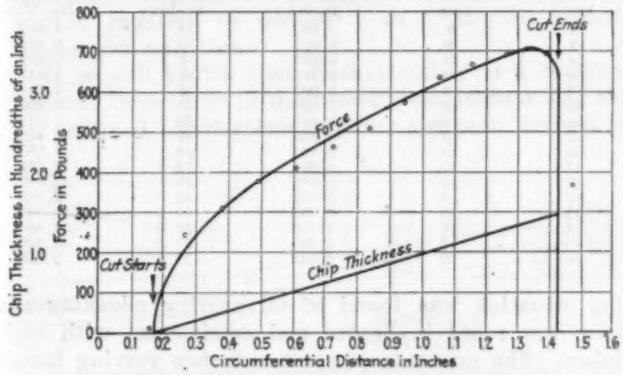


FIG. 3. FORCE-SPACE CURVE OF CHIP FORMATION

Howard L. McGregor, of the National Twist Drill and Tool Co. Thanks are accorded to H. M. Leland, who willingly made the facilities of the Lincoln Motor Co. available, and to Roy D. Chapin, who similarly opened the extensive Hudson plant. Acknowledgment is also made of the unfailing courteous co-operation given by R. L. Welborn, of the Lincoln Motor Co., and by I. B. Swegles of the Hudson company. Lastly, acknowledgment is made of the invaluable assistance rendered throughout by Ingle B. Whinery, on whom the brunt of the work fell. Mr. Whinery was connected with this work from the start; first as a graduate student at the University of Michigan and later, throughout the year 1920-21, as holder of a National Small Tool Fellowship (awarded by the National Twist Drill and Tool Co.) and finally as an engineer with the company. Mr. Whinery, ably assisted in the troublesome development stage of equipment, later conducted most of the experiments personally and finally prepared all the data for this paper.

The chip taken by a plain slab mill is very different from the chip taken by a lathe or shaper tool. A milling chip is shown exaggerated in the shaded portion of Fig. 1. The two circles show the outline of the cutter at the beginning and at the end of the interval taken for the cutter to revolve through the angle subtended by one tooth. The shaded portion will therefore represent the material removed by one tooth and will have an area fxd.

The chip starts infinitely thin and its thickness gradually increases to a maximum just before the finish, from which point it quickly decreases. This decrease is practically instantaneous in an unexaggerated chip. The question arises, how does the force vary throughout the cutting of this chip?

The first problem is to find how the tangential force varies in relation to chip-thickness. For measuring this force while the chip is being formed under reasonable commercial velocity conditions, a dynamical measuring method is the only solution, as a chip is completely cut in about one-tenth of a second.

Description of Chip Investigator.—Fig. 2 is a diagrammatic representation of the apparatus here known as the chip investigator. A block of material is shown bolted to a milling machine table and a single-tooth cutter in place, the latter being rigidly attached to the sector-shaped arm. This arm can partially rotate about an axis at its lower end, and in so doing, it carries the cutter through an arc long enough to make a chip of the desired length.

If the arm be allowed to fall freely, the angular velocity will increase throughout the fall. If this be repeated after the table is adjusted so as to cause a cut to be taken, then the next fall of the arm will be retarded, because it must give up sufficient energy to do the cutting. Weights can be placed on the pad for additional weights (see Fig. 2), sufficient to secure a roughly uniform speed during cutting.

The investigation of the velocity at each instant is made by means of a tuning fork, which gives a record on smoked paper. The outer surface of the arm, remote from the axis of oscillation, is concentric: to this a glazed paper ribbon is attached and then smoked by a gas flame.

An angle iron bolted to the front face of the machine carries at its upper end a Koenig electrically driven tuning fork making 500 vibrations per second. As the arm falls, a wavy line is traced on the smoked paper by a stylus attached to one leg of the tuning fork. Each wave represents a definite interval of time, viz., two one-thousandths of a second. The smoked paper record is immediately dipped in thin shellac varnish and hung to dry.

The analysis and computation of smoked paper records is given fully in Appendix No. 1. An example of a chip study is given in Fig. 3, where it is very clearly

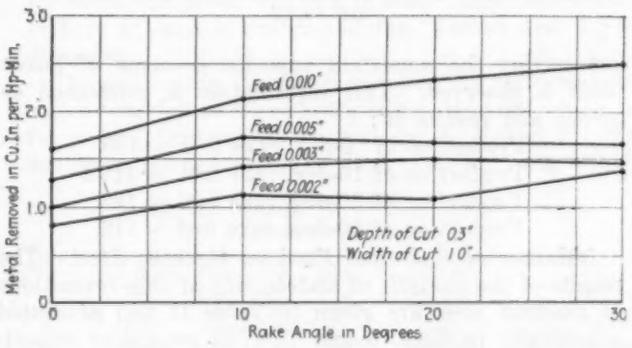


FIG. 4. CAST IRON: METAL REMOVED AS FUNCTION OF RAKE

shown that the force employed is not proportional to the chip thickness. In other words, material is removed more efficiently as the chip becomes thicker. This is confirmed later by experiments on varying feeds and furnishes the true explanation of the supposed advantages of coarse tooth cutters.

Over twelve hundred chips were cut and the energy computed. These were taken at three different cutting speeds, viz., 17.5, 32 and 44 ft. per minute, respectively. The average of the energy required at different speeds was remarkably equal. If the energy used at lowest speed be taken as 100, the results are:

Speed in feet per minute.	17.5	32	44
Energy	100	101.8	97.4

As there appears no law in this and the variation is slight, presumably due to experimental error, the conclusion was reached that speed does not influence energy required.

Influence of Rake and Feed on Cast Iron.—The results of the analysis of sixteen sets of chip-formations in cast iron are given in Table I and shown graphically in Figs. 4 and 5. Each set consists of three chips formed at the different speeds, as stated in a previous paragraph.

The area under each curve gives a numerical representation of the average production of each tool over a certain region of chip weight. Taking the 0-deg. rake tool as 100 we have:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 133
Production of 20-deg. rake tool = 138.4
Production of 30-deg. rake tool = 142.1

Influence of Rake and Feed on Bronze.—The results of the analysis of sixteen sets of chip-formations in bronze are given in the following table. As in the

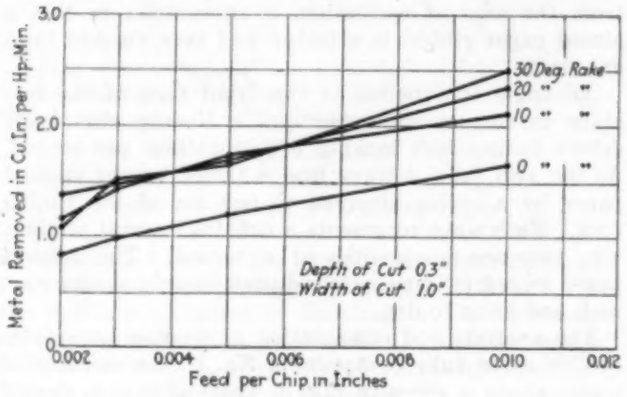


FIG. 5. CAST IRON: METAL REMOVED AS FUNCTION OF FEED

last section the consistent superior economy of heavy feeds is observed. This information is condensed as before and results in:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 113.2
Production of 20-deg. rake tool = 123
Production of 30-deg. rake tool = 118

Influence of Rake and Feed on Machine Steel.—The results of the analysis of sixteen sets of chip-formations of machine steel are given in Table II and presented graphically in Figs. 6 and 7. The consistent superiority of heavy feeds is again noted. Again condensing the above information:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 118.7
Production of 20-deg. rake tool = 157.2
Production of 30-deg. rake tool = 172

Influence of Rake and Feed on Carbon Tool Steel.—The results of the analysis of sixteen sets of chip-formations of tool steel are given in Table III, and graphically in Figs. 8 and 9. Again condensing the above information:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 106
Production of 20-deg. rake tool = 112.2
Production of 30-deg. rake tool = 112.0

Effect of Lubrication.—Various experiments were run with lubricant. The results must be taken qualitatively rather than quantitatively. This topic offers an important field of investigation for future experiments.

In milling there is a decided influence entirely apart from heat-conducting properties. If the surface exposed by the last chip was very slightly smeared with an oiled finger (the oil film was scarcely discernible), the energy consumed in taking the next chip was from 10 to 25 per cent lower in nearly all cases.

On plotting batches of results, however, the surprising situation was found of oil proving advantageous with low rakes in bronze and detrimental with high rakes. The existence of some unknown varying factor was suspected and the result would have been rejected and forgotten but for the fact that the same effect showed up in experiments with machine steel made at a different time. The metal removed per horsepower-minute is shown plotted against rake for the two materials in Fig. 10.

TABLE I. INFLUENCE OF RAKE AND FEED IN CUTTING CAST IRON

Clearance angle, 2 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 1 in.

Experiment No.	Rake Angle, Deg.	Feed in Inches	Energy in Ft.-Lb.	Cu.In. per Hp.-Min.
52	0	0.002	24.2	0.818
53	0	0.003	30.4	0.977
54	0	0.005	38.3	1.293
55	0	0.010	60.8	1.627
59	10	0.002	17.3	1.143
60	10	0.003	21.1	1.407
61	10	0.005	28.9	1.712
62	10	0.010	47.1	2.105
66	20	0.002	18.1	1.093
67	20	0.003	19.8	1.500
68	20	0.005	29.3	1.690
69	20	0.010	42.7	2.319
73	30	0.002	14.2	1.394
74	30	0.003	20.6	1.441
75	30	0.005	29.7	1.666
76	30	0.010	39.6	2.500

The authors hesitate to accept the foregoing unreservedly until further investigation sheds some light on its rationality. A study of the resultant force during the formation of a chip with reference to its changing magnitude and *direction* would give the needed explanation. This has not yet been undertaken.

Effect of Chatter.—When chatter occurs, violent fluctuation of energy results. The energy consumed was usually greater than with smooth cutting. The authors believe that, due to chatter alone, *increase* of energy invariably results and that, where a decrease appeared,

TABLE II. INFLUENCE OF RAKE AND FEED IN CUTTING MACHINE STEEL

Clearance angle, 3 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 1.0 in.

Experiment No.	Rake Angle, Deg.	Feed in Inches	Energy in Ft.-Lb.	Cu.In. per Hp.-Min.
250	0	0.0025	45.1	0.549
251	0	0.0050	72.8	0.680
252	0	0.0075	94.3	0.787
253	0	0.0100	103.1	0.960
289	10	0.0025	38.8	0.638
290	10	0.0050	60.0	0.825
291	10	0.0075	76.8	0.967
292	10	0.0100	94.4	1.049
260	20	0.0025	25.0	0.990.
261	20	0.0050	46.3	1.068
262	20	0.0075	59.9	1.240
263	20	0.0100	71.4	1.386
265	30	0.0025	25.9	0.955
266	30	0.0050	41.2	1.200
267	30	0.0075	55.0	1.350
268	30	0.0100	62.5	1.584

it was caused by the cut being lighter than supposed to be. This can be brought about by the chatter causing an increase of force normal to the work and this in turn springing the work or cutter. A detailed study of chatter was not made but probably will be at a later date.

Effect of Clearance.—Clearance was found not to affect energy consumed. Chatter, wear of tool and liability of tool to snip are affected by clearance.

Effect of Spiral.—Experiments were carried out on the effect of spirals. The results were not sufficiently uniform to justify a conclusion on the influence of spiral angle on energy, beyond the fact that cutters with spiral angles of over 25 deg. certainly require more energy.

Method of Determining Machineability.—The word "machineability" is suggested to indicate the ease with which a given material can be machined. This, of course, presupposes standardized conditions of tool and size and shape of chip. If all conditions be standardized except the quality of the material being cut, then the machineability can be expressed in foot-pounds of energy required to remove 1 cu.in. of the material under investigation.

It is well known that machineability is a continual bone of contention in machining departments and that no accepted satisfactory way has yet been devised for

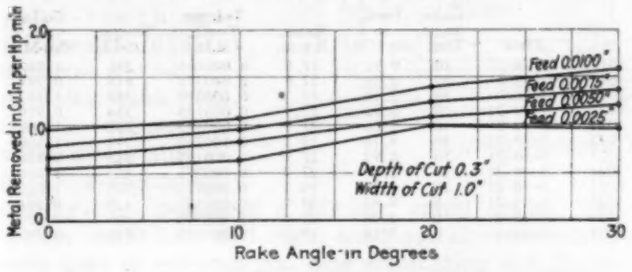


FIG. 6. MACHINE STEEL: METAL REMOVED AS FUNCTION OF RAKE

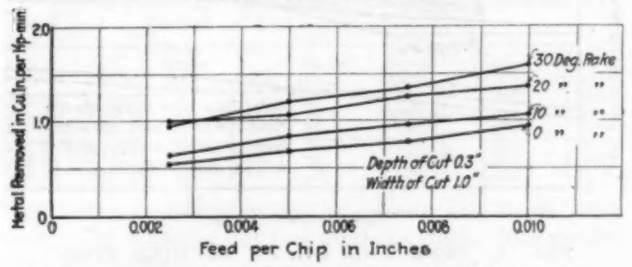


FIG. 7. MACHINE STEEL: METAL REMOVED AS FUNCTION OF FEED

its measurement. It is generally admitted that even though chemical analysis, tensile strength, elongation, Brinell hardness number and scleroscope hardness number are known, yet the machineability is an unknown factor. In fact, the War Department gave to the American Research Council as their major topic the development of some definite means of determining machineability.

A machine has been developed along these lines and is described later in the paper. For identification purposes, this is referred to as the "Machineability Tester." Experiments with this machine are presented at the end of the paper rather than here, because they were the last experiments to be performd.

To summarize: The authors had, at this state of development, no definite idea leading to a rational structure which would connect up the results. They regard the work in this section as useful in opening up territory, thereby enabling them to formulate more definite layouts for subsequent work and believe that broadly the following conclusions are justified: (*a*) As a chip thickens, metal is removed more easily per unit volume; (*b*) As rake angle is increased, metal is removed more easily per unit volume. Also this improvement is continuous but not uniform; (*c*) The advantage of rake depends on the material and is more pronounced with ductile materials; (*d*) The effect of lubrication proper (apart from cooling action) is decided, but the information available is inadequate to formulate it.

Complete Force Analysis of Cutter in Action

Numerous experiments on power consumption have been made by different investigators, but the method employed has been to measure the electrical input required to drive the machine. This confuses the unknown action of the cutter with the unknown machine loss and has therefore been rejected for the present investigation.

TABLE III. INFLUENCE OF RAKE AND FEED IN CUTTING TOOL STEEL

Clearance angle, 3 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 0.25 in.

Experiment No.	Rake Angle, Deg.	Feed in Inches	Energy in Ft.-Lb.	Cu.In. per Hp.-Min.
331	0	0.0025	39.6	0.625
332	0	0.0050	64.0	0.774
333	0	0.0075	89.5	0.830
334	0	0.0100	102.8	0.960
336	10	0.0025	43.1	0.575
337	10	0.0050	60.7	0.820
338	10	0.0075	79.5	0.924
339	10	0.0100	97.6	1.012
341	20	0.0025	38.8	0.639
342	20	0.0050	60.4	0.819
343	20	0.0075	73.7	1.005
344	20	0.0100	90.0	1.100
346	30	0.0025	37.6	0.659
347	30	0.0050	59.3	0.832
348	30	0.0075	76.1	0.972
349	30	0.0100	90.9	1.095

Features to be Measured. It was thought desirable to measure both the vertical and the horizontal components of the force exerted by the cutter. This necessitated developing an instrument that would measure both force and location, i.e., in all, three quantities—magnitude, direction and location. Or, which amounts to the same thing, the two components and the location may be measured.

Description of Equipment. The apparatus developed for force and power analysis is shown diagrammatically in Fig. 11, and is designated the "Thrust and Torque Measurer."

The angle plate (to which is bolted the material being cut) is carried on three knife edges, through which the forces are transmitted to pistons *A*, *B* and *C*. The double-knife-edge principle used transmits only a horizontal force to piston *A* and only vertical forces to pistons *B* and *C*.

TABLE IV. INFLUENCE OF RAKE IN CUTTING MACHINE STEEL

Number of teeth, 34; clearance angle, 5 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 0.5 in.

Exp. No.	Date	Rake Angle, Deg.	Feed, in per Min.	Speed, R.p.m.	Vol. per Tooth, Cu.In.	Torque, In.-Lb.	Cu.In. per Hp.-Min.
1001	2-23-21	0	0.92	27.9	0.000145	693	0.448
1002	2-23-21	0	2.36	27.9	0.000375	1,390	0.585
1003½	2-23-21	0	3.10	19.3	0.000710	2,050	0.748
1004a	2-24-21	10	0.92	27.9	0.000145	455	0.685
1005	2-24-21	10	2.36	27.9	0.000375	980	0.830
1006	2-24-21	10	3.10	19.3	0.000710	1,710	0.896
1007	2-25-21	10	0.92	27.9	0.000145	488	0.637
1008	2-25-21	10	2.36	27.9	0.000375	1,040	0.781
1010	2-29-21	0	0.92	27.9	0.000145	618	0.504
1011	2-29-21	0	2.36	27.9	0.000375	1,260	0.645
1012	2-29-21	0	3.10	19.3	0.000710	1,954	0.783
1013	3- 7-21	20	0.92	7.9	0.000145	291	1.068
1014	3- 7-21	20	2.36	27.9	0.000375	740	1.100
1015	3- 7-21	20	3.10	19.3	0.000710	1,432	1.070

The fluid pressure under the pistons is transmitted through pipes and measured by means of mercury columns shown at the left of Fig. 11. As the table travels in feeding, the location of the downward thrust of the cutter in relation to cylinders *B* and *C* changes continuously. The table traveling from left to right results in the pressure decreasing on *C* and increasing on *B*. The

readings of mercury columns must therefore be taken for known definite locations of table. Five marks were made in the table, and as these successively came into

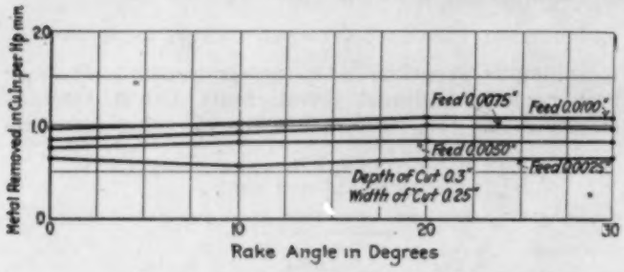


FIG. 8. TOOL STEEL: METAL REMOVED AS FUNCTION OF RAKE

alignment with a zero mark on the saddle, the readings were taken.

Influence of Rake on Machine Steel. The results of fourteen experiments are shown in Table IV and graphically in Fig. 12. The noticeable consistency in the spacing of the pairs of values given as results of the zero rake cutter is due to the second three having been taken in a different part of the block from the first three. The results plotted in Fig. 12 show the decided advantage of rake. The advantage of heavy chips is also clearly shown except in the case of the 20-deg. tool.

The authors do not draw any conclusion regarding

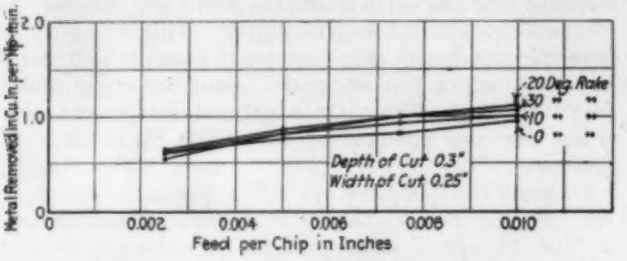


FIG. 9. TOOL STEEL: METAL REMOVED AS FUNCTION OF FEED

this exceptional case as the experiments available are too few. In general there is conclusive evidence that heavy chips are more economical of power than small chips, within the practical limits of present-day milling practice. The exact extent of this economy cannot be stated at the present state of the art. It is certain, however, that this condition is a function both of the material and of the rake. The influence of rake appears to depend largely on ductility.

The area under each curve gives a numerical repre-

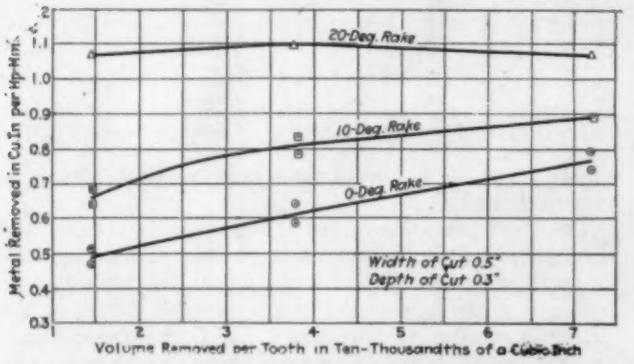

Metal Removed in Cu.In. per Hp.-Min.
20-Deg. Rake
10-Deg. Rake
0-Deg. Rake
Width of Cut 0.5"
Depth of Cut 0.3"
Volume Removed per Tooth in Ten-Thousandths of a Cubic Inch

FIG. 12. INFLUENCE OF RAKE IN CUTTING MACHINE STEEL

sentation of the average production of each tool over a certain region of chip weight. Taking the 0-deg. rake tool as 100 we have:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 130
Production of 20-deg. rake tool = 176

Influence of Rake on Alloy Steel. The results of twelve experiments are shown in Table V and in Fig. 13. Again taking the area under the curve to represent the productivity, we obtain:

Production of 0-deg. rake tool = 100
Production of 10-deg. rake tool = 130.5
Production of 20-deg. rake tool = 137.5

In this case the advantage of rake is not so decided as with the more ductile machine steel—particularly above

TABLE V. INFLUENCE OF RAKE IN CUTTING ALLOY STEEL
Number of teeth, 34; clearance angle, 5 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 0.5 in.

Exp. No.	Date	Rake Angle, Deg.	Feed, in per Min.	Speed, R.p.m.	Vol. per Tooth, Cu.In.	Torque, In.-Lb.	Cu.In. per Hp.-Min.
1017	3- 8-21	20	0.92	27.9	0.000145	296	1.048
1018	3- 8-21	20	2.36	27.9	0.000375	818	0.994
1019	3- 8-21	20	3.10	19.3	0.000710	1,340	1.142
1020	3- 9-21	10	0.92	27.9	0.000145	334	0.930
1021	3- 9-21	10	2.36	27.9	0.000375	782	1.040
1022	3- 9-21	10	3.10	19.3	0.000710	1,392	1.100
1023	3-10-21	10	0.92	27.9	0.000145	363	0.856
1024	3-10-21	10	2.36	27.9	0.000375	803	1.010
1025	3-10-21	10	3.10	19.3	0.000710	1,505	1.020
1029	3-15-21	0	0.92	27.9	0.000145	429	0.706
1030	3-15-21	0	2.36	27.9	0.000375	1,045	0.778
1031	3-15-21	0	3.10	19.3	0.000710	1,930	0.795

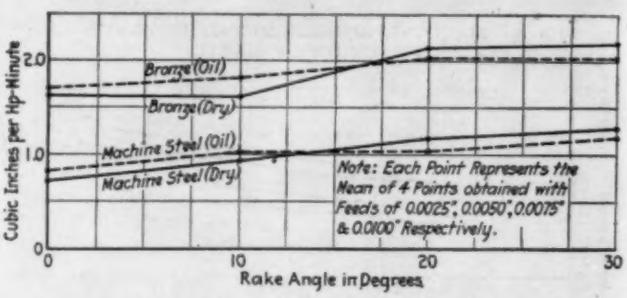

Cubic Inches per Hp-Minute
Bronze (Oil)
Bronze (Dry)
Machine Steel (Oil)
Machine Steel (Dry)
Note: Each Point Represents the Mean of 4 Points obtained with Feeds of 0.0025", 0.0050", 0.0075" & 0.0100" Respectively.
Rake Angle in Degrees

FIG. 10. EFFECT OF OIL ON MACHINE STEEL AND BRONZE

10 deg. In addition, the same tendency is observed to reduce the advantage of thicker chips with a high rake.

Influence of Depth of Cut. Thirty-five experiments were run with various depths of cut, various feeds, and two different rakes. Analysis of these results gave rise to a belief that the block of material used was far from homogeneous. These experiments are not recorded in detail for this reason. It is advisable, however, to record certain impressions obtained and tentative conclusions.

If material removed per horsepower-minute be plotted on a chip-volume base, then a shallow cut gives a curve higher than a deeper cut. This is not surprising. It has been shown that, as a chip thickens, the material is removed with less energy per unit volume. If two chips of equal volume but of different depths of cut be taken, then the chip of the shallow cut is shorter and thicker.

It appeared probable that, with a given cutter and uniform material, if the feed per tooth and depth of cut were varied, the number of cubic inches per horsepower-minute would prove to be a definite function of maximum chip thickness. Experimental verification of this is given later in the paper.

Influence of Lubricant. The results of six experiments, which merely touched the fringe of the effect of lubrication, are given in Table VI. It is dangerous

to generalize too broadly from a few results, but one can at least conclude that lubrication effects a reduction of energy and that this reduction appears more pronounced in light cuts. It should be again noticed that this is almost pure lubricating action and that the conduction of heat by the oil plays only an insignificant part.

Effect of Spiral. A 34-tooth non-spiral cutter, 6 in. in diameter and having a 10-deg. rake, was run in comparison with cutters similar in all respects excepting they possessed a 12½-deg. spiral angle. Two cutters with left- and right-hand spirals respectively were used in combination, thus eliminating end thrust.

FIG. 11. DIAGRAM OF THRUST AND TORQUE MEASURER.

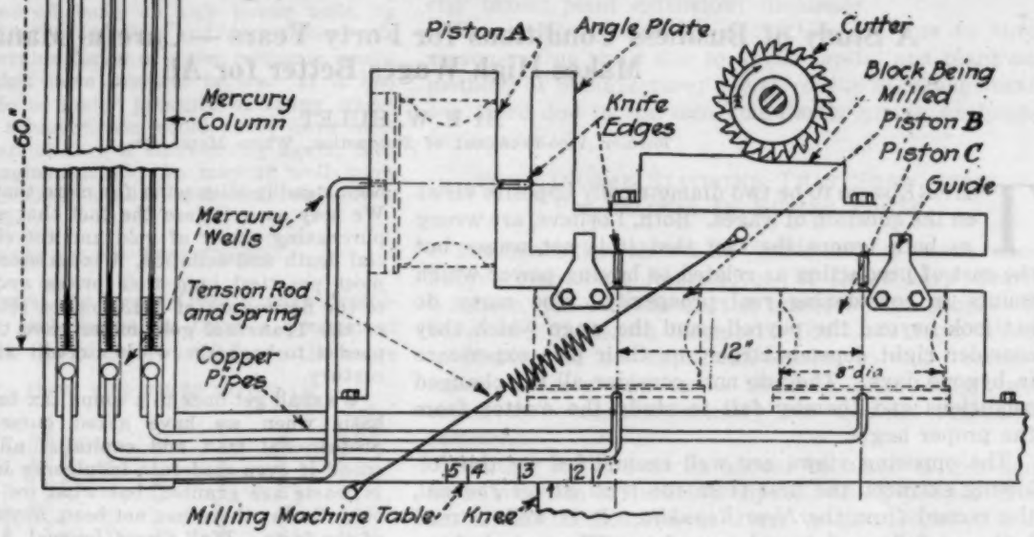


TABLE VI. EFFECT OF LUBRICATION

Number of teeth, 34; clearance angle, 5 deg.; spiral angle, 0 deg.; depth of cut, 0.3 in.; width of cut, 0.5 in.

Exp. No.	Date	Rake Angle, Deg.	Feed, in per Min.	Speed, R.p.m.	Vol. per Tooth, Cu.In.	Torque, In.-Lb.	Cu.In. per Hp.-Min.
1026 oil	3-10-21	10	0.92	27.9	0.000145	306	1.018
1026 dry	3-10-21	10	0.92	27.9	0.000145	364	0.855
1027 oil	3-10-21	10	2.36	27.9	0.000375	760	1.070
1027 dry	3-10-21	10	2.36	27.9	0.000375	875	0.930
1028 oil	3-10-21	10	3.10	19.3	0.000710	1,335	1.148
1028 dry	3-10-21	10	3.10	19.3	0.000710	1,430	1.071

Two different combinations of speeds and feeds were used. The material cut was machine steel. The results were as follows:

R.p.m.	Feed, In. per Min.	Cubic Inches per Hp.-Min. 0 Deg. Spiral	12½-Deg. Spiral	Lost Output of Spiral Cutter, per Cent
28.1	0.92	0.422	0.338	20
16.1	0.92	0.568	0.458	19.4

The authors are well aware that a general belief exists in the superior power efficiency of spiral cutters. Frequent statements to this effect can be found in the literature of the subject. In this investigation it has been impossible to substantiate these. It is difficult to understand the growth of the belief that spiral cutters are more efficient, because abstract analysis leads to the conclusion that spiral cutters must be inferior to straight cutters. By "inferior," the meaning intended is in reference to power efficiency only. The use of a spiral angle is heartily recommended, for it results in continuity of action, tends to avoid chatter and keeps the driving power more smoothly constant. The smallest angle consistent with smoothness of action should be used.

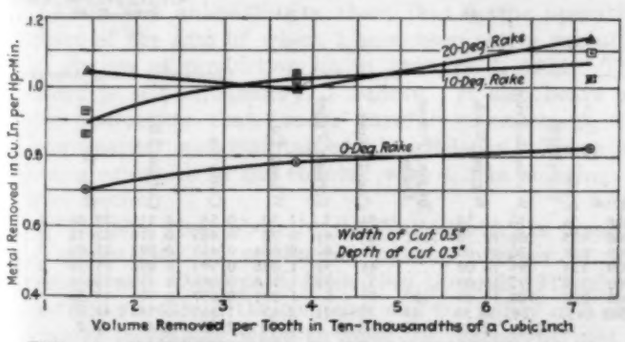


FIG. 13. INFLUENCE OF RAKE IN CUTTING ALLOY STEEL

(To be continued in next week's issue.)

Safety in Elevator Construction

Nearly three-quarters of the fatal elevator accidents that occur could be prevented if elevators and shaftway doors were equipped with well-designed interlocking devices. A survey and study conducted by the Bureau of Standards of the Department of Commerce has shown this to be true.

A large number of elevator fatalities occur at the shaft door, either through an open door which allows a person to fall down the shaft or it allows a person to step from a moving car and be crushed between the car and the door frame. An inter-lock prevents the shaft door from being opened except when the car is at rest in front of the door.

Elevator safety is declared to be as important as street car safety. The Bureau of Standards investigators have found that about as many ride on elevators as on all the city traction lines. Postmen, messengers, and others rely on them and their safety devices to a large extent.

In providing vertical transportation, elevators travel long distances each day and make many stops. For instance, an elevator in the Woolworth Building travels about 40 miles a day and makes 4,000 stops in that time.

A Question as to the Date of the First Pull Broach

BY FRANK G. STERLING

An article appearing on page 391 of the *American Machinist* states that it was not till 1901 that the pull broach was used.

I would like very much to see this statement corrected, for we have a pull broach, called a splining machine at the time, in our shops, which was bought new in 1884. How long before that date it was on the market I cannot say. It was made by the Knowles Loom Works, Worcester, Mass.

Cutting Wages the Sure Way to Retard Business Resumption

A Study of Business Conditions for Forty Years — Careful Management Makes High Wages Better for All

By E. W. HULET
Former Vice-President of Production, White Motor Co.

THERE seem to be two diametrically opposite views on the question of wages. Both, I believe, are wrong as both ignore the fact that it is not wages but the cost of production as related to buying power which counts in considering real prosperity. Too many do not look beyond the payroll—and the wage which they consider right depends largely on their own experience in bygone days. They do not consider all the changed conditions and thereby fail to study the matter from the proper angle.

The opposing views are well exemplified by the following extracts, the first from the *Wall Street Journal*, the second from the *New Republic*. It is well to read both carefully and to ask ourselves, "How much have high wages and salaries contributed to our prosperity?"

Do We Want To Go Back to a Lower Plane?

When we use that phrase, "The American standard of living" so dear to the Labor Department under the Wilson regime, and to others who measure by what they want rather than by what they need, it is as well to assure ourselves that what we mean is not the American standard of waste. An inquiring commission, chiefly composed of engineers, has easily discovered possible economies in production, which are most of them, as might be expected, conditional on the co-operation and good will of the producers.

Because the wish is father to the thought, we are authoritatively assured that wages will never again reach the level of 1913, nor will the necessaries of life be sold at the prices current then. But both wages and prices had then been steadily advancing for more than ten years previously. We may as well face the fact that with the now enhanced purchasing power of gold and the choice between commercial death and deflation, it is an economic possibility of the most practical kind that prices and wages may go back to the figure, not of 1913, but of 1901, when the reopening of the Transvaal gold mines gave the world more than it needed to back the world's credit at the beginning of the century.

We shall get back to a sound tax basis and a sound income basis when we have asked ourselves—laborer, artisan, professional man and capitalist alike—not what we can spend if even moderate indulgence in luxuries and leakage in waste are granted, but what we can save and do without. So far there has not been, anywhere, an honest facing of the facts.—*Wall Street Journal*, Aug. 25, 1921.

When profits disappear suddenly in the depths, business calls upon the wage earner to practice thrift and self denial. The exhortation is utterly wasted. Once having lived better, people will not go back. They cannot be reconciled to former conditions. The equilibrium has to be restored in another way. An examination of the statistics would lead us to infer that labor's share increases all the time, whatever happens to prices. And the implication is that labor will get everything and there will be no profit in business.

Not so. This has been going on for a very long time and the profit in business has not tended to vanish. Though labor's command over goods is increased, it does not follow that its share in the total product is greater. There are more goods to be shared.

The first thing created is a necessity and the necessity creates new wealth. The producer cannot bring wages

TABLE NO. 1—BUSINESS BAROMETERS USED AS A BASIS FOR DEDUCTIONS IN ARTICLE

	Population	Wealth per Capita	Money per Capita	Wage per week	Farms and Mines	Ratio to Population	Manufacturing	Ratio to Population	Total Farms and Mines Plus Manufacturing	Ratio to Population	Volume of Foreign Trade	Ratio to Population	Bank Clearings	Ratio to Population
1880	50,155,783	876.20	19.41	11.50	6,000,000,000	120	5,370,000,000	107	11,370,000,000	227	1,586,490,000	30	11,375,400,000	223*
													49,989,848,000	1,000†
1890	62,947,704	1,035.57	27.82	12.50	6,000,000,000	95	9,372,000,000	148	15,372,000,000	243	1,680,900,000	26	23,370,482,000	370*
													60,829,090,000	965†
1900	75,994,575	1,164.79	26.93	13.00	7,000,000,000	92	11,407,000,000	150	18,407,000,000	242	2,307,095,000	30	33,436,348,000	438*
													86,070,550,000	1,130†
1905	82,000,000	1,318.00	.....	14.00	8,000,000,000	95	10,794,000,000	120	22,672,000,000	215	2,806,135,000	30	50,005,388,000	624*
													143,827,448,000	1,764†
1910	91,972,266	1,800.00	34.33	15.00	10,000,000,000	108	20,672,000,000	225	30,672,000,000	333	3,429,163,000	37	66,820,730,000	726*
													164,095,230,000	1,882†
1915	100,000,000	2,076.00	34.31	15.00	16,000,000,000	160	24,246,000,000	242	40,246,000,000	402	5,333,267,000	53	77,253,172,000	772*
													187,817,564,000	1,878†
1920	110,000,000	3,600.00	57.09	34.50	37,500,000,000	340	62,500,000,000	568	100,000,000,000	908	13,950,125,000	145	208,132,574,000	1,900*
													451,272,242,000	4,070†
1920 over 1915		.....	.....	2.30	2.34	...	2.54	...	2.48	...	2.61		2.69—2.40	....

* Totals excluding New York. † Totals including New York.

					Manufacturing Only						Money Rates		Commodity Prices Average				
	Population	Wealth per Capita	Money per Capita	Wage per Week	Manufacturing	Ratio to Population	Invested Capital	Ratio to Population	Wholesale Price	Wg. per Week	Buying Power Dollar	Com'l Paper	Foreign Paper	Wheat, Bu.	Corn, Bu.	Cotton, Lb.	Iron, Ton	Copper, Lb.
1880	50,155,783	876.20	19.41	11.50	5,370,000,000	107	2,790,000,000	56	110	11.50	....	5½	3	1.30	0.55	0.115	29.86	0.214
1890	62,747,714	1,035.57	27.82	12.50	9,372,000,000	148	6,525,000,000	103	80	12.50	....	6	4½	0.92	0.485	0.110	15.10	0.156
1900	75,994,575	1,164.79	26.93	13.00	11,407,000,000	150	9,813,000,000	128	70	13.00	....	5	4	0.804	0.453	0.092	17.04	0.166
1905	82,000,000	1,318.00	.....	14.00	10,794,000,000	120	12,676,000,000	154	85	14.00	....	4½	3½	1.028	0.593	0.098	15.57	0.156
1910	91,972,266	1,800.00	34.33	15.00	20,672,000,000	225	18,428,000,000	200	95	15.00	....	5½	3½	1.118	0.668	0.151	15.16	0.129
1915	100,000,000	2,076.00	34.31	15.00	24,672,000,000	242	22,791,000,000	228	100	15.00	100	3½	5	1.291	0.837	0.101	13.58	0.174
1920	110,000,000	3,600.00	57.09	34.50	62,500,000,000	568	50,000,000,000	455	245	34.50	45	7½	5½	2.65	1.669	0.346	44.03	0.175
1920 over 1915		.....	.....	2.30	2.54	...	2.15	...	2.45	2.30	0.45	2.00	...	2.00	2.00	3.4	3.2	.....

** Wheat per bu. Corn, bu.; Cotton, lb.; iron, ton.
NOTE.—All figures are rough, but are within 5 per cent of being correct in all cases Aug. 26, 1921.

down to where they were before. But presently he discovers that he is not primarily interested in wages as such. His proper study is the labor cost of production.

The problem of business is not how to liquidate wages but how to liquidate labor costs which may be done by increasing the use and efficiency of high power tools, by improving its method of production and distribution and by eliminating innumerable forms of gross economic waste. Industry has faced this same problem before. If it had not been obliged to do so under pressure of rising wages many of the modern achievements would never have come to pass. And if it cannot face it successfully again, then it is bankrupt in imagination and we may as well know that the peak of American wealth is behind us.—*New Republic*, June 22, 1921.

A Modification of Two Views

The above quotations, one taken from a very prominent financial paper and the other from a prominent progressive paper, are the two views taken on the wage

TABLE II. DATA FROM THE WHITE MOTOR CO.

Year	Factory Value of Product	Average No. Men	Estimate Buying Power of $1.00	Average Weekly Earnings Based on 51 Weeks' Work	Hours' Work	Hours' Pay	Total Wages	Trucks per Man per Year	Factory Value of Trucks Produced per Man per Year*
1910	$3,836,290	1,072	....	$14.04	60	60	$767,496	2.290	$3,578.63
1911	5,097,523	1,419	....	12.82	59	60½	927,696	1.985	3,592.33
1912	6,739,756	1,852	....	13.53	59	61½	1,278,426	1.785	3,639.17
1913	6,795,196	1,964	....	13.45	59	61½	1,347,064	1.785	3,459.87
1914	9,023,172	2,202	$1.00	15.03	59	61½	1,688,467	1.924	4,097.72
1915	21,040,078	3,758	.90	16.51	54½	59½	3,163,857	2.460	5,598.72
1916	17,053,311	3,611	.86	17.34	54½	59½	3,186,921	2.082	4,722.60
1917	22,448,927	4,341	.72	20.94	54½	59½	4,637,105	2.040	5,171.33
1918	30,952,748	4,844	.55	27.07	54½	59½	6,688,051	2.720	6,389.91
1919*	35,356,000	5,475	.50	31.64	49½	52	8,835,000	2.751	6,456.62
1920	50,246,448	6,600	.40	37.87	49½	52	13,485,012	3.017	7,613.00

* December, 1919, estimated.

NOTE.—Trucks per man, 2.571; value, $6,456.62; average value, $2,347.00 per truck. Average truck price increased approximately 17 per cent over 1914.

adjustment, so called, that is in everyone's mind at the present time. I believe the two papers in question are sincere in their deductions and my only aim is to moderate, if possible, the sentiments of both.

I have submitted some information that has come to my attention on investigating these matters. I question whether the financier, business man and others realize how much the high wages, so called, and salaries paid in our country have helped, by raising the buying power of our masses, to contribute to our prosperity. This is particularly marked in 1920, as shown by Table No. 1. It also shows that the growth of 1920 over 1915 follows very closely the same ratios in all factors making up our business progress. Wages only follow the general trend. Consequently, in my mind, the wage earner is acquitted of the charge of taking too much of the fruits of our prosperity.

Product and Wages

I am also submitting a chart that is the operating chart of the firm of which I have been active executive in charge of production up to January 1, 1921. This chart is self-explanatory, I believe. It also bears out my contention that, under careful management, the wage earner has maintained his efficiency. There are many examples in the country with a like showing, or even better.

The table given above by the White Motor Co. presents a comparison of production values, number of employees and wages paid, from 1910 through 1919, showing the growth of the company and the policy of a constantly increasing wage to meet the increasing cost of living.

The factory value of the trucks produced includes: Merchandise and supplies, etc.; labor; power and fuel; maintenance and repair; factory salaries and general administrative expense; insurance; federal, state and city taxes; plant extension; dividends.

The results shown by the tables are due to three reasons: One third due to ample capital and plant and methods of manufacture; one third due to management; one third due to the men voluntarily giving an honest day's work.

Some Income Statistics That Show Great Possibilities In Buying Power

The statistics shown in Table No. 3 make these figures even more impressive. It shows very clearly, I believe, the possible buying power of our people who have very moderate incomes. The class from $1,000 to $5,000 and up, applies of course to wage earners, salary earners and small business men. The table seems to be self explanatory and to need very little comment.

Another feature which should be noted is the enormous increase in invested capital, which jumped from under $23,000,000,000 in 1915 to $50,000,000,000 in 1920—about 2.15 times. It is a question as to how much this can be liquidated without heavy loss to the holders.

If wages, production, foreign trade, bank clearances, wholesale prices, commodity prices go down this figure must also take its proportion of drop. In other words, the question could be asked, how far can general prices and business drop without ruination to our capital account? At the present time, capital accounts and retailers are not following the general trend of prices in most cases. When statements are submitted this coming January, capital accounts, I believe, will be forced to follow.

The Final Analysis

The deduction from the information on these three tables would lead me to believe that the one sure way

TABLE III. STATISTICS OF INCOME

From Commissioner of Internal Income

1918

No. of Returns	Class	Income	Per Cent
3,946,152	1,000 to 5,000	9,404,398,417	59
435,925	5,000 to 20,000	3,516,017,672	22
43,027	20,000 up	3,004,223,266	19
4,425,114		15,924,639,355	

Income Classes	Net Income	Wage and Salaries	From Business Partnerships Sale of Real Estate, Rents and Royalties, per Cent	Dividends and Interest on Investments, per Cent
1,000 to 2,000	2,232,354,577	74.67%*	17.48	7.85
2,000 to 3,000	3,626,824,833	65.42%*	26.89	7.69
3,000 to 5,000	3,535,219,007	48.56%	39.53	11.91
5,000 to 10,000	2,145,690,016	33.55%	44.86	21.59
10,000 to 20,000	1,370,327,656	33.10%	33.48	33.42
	12,920,416,089			
All others.....	3,004,223,266			
	15,924,639,355	Total personal		
	8,361,511,249	Total corporation		
	24,286,100,604	Total income reported.		

to keep business from coming back would be to cut wages and salaries and reduce forces.

In other words, to let the production force of our country take the brunt of the readjustment is sure to retard the return of good business.

How Work Goes Through the Shop

Studying the Passage of Work Through Different Departments—Following Orders Through the Shop—How the Data Are Charted and Arranged

SPECIAL CORRESPONDENCE

THE only way to thoroughly visualize the routing of work through a shop is to have it actually before you so as to see the exact relation of each department to the others. In order to do this easily and effectively, W. O. Sims, supervisor of tools of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio,

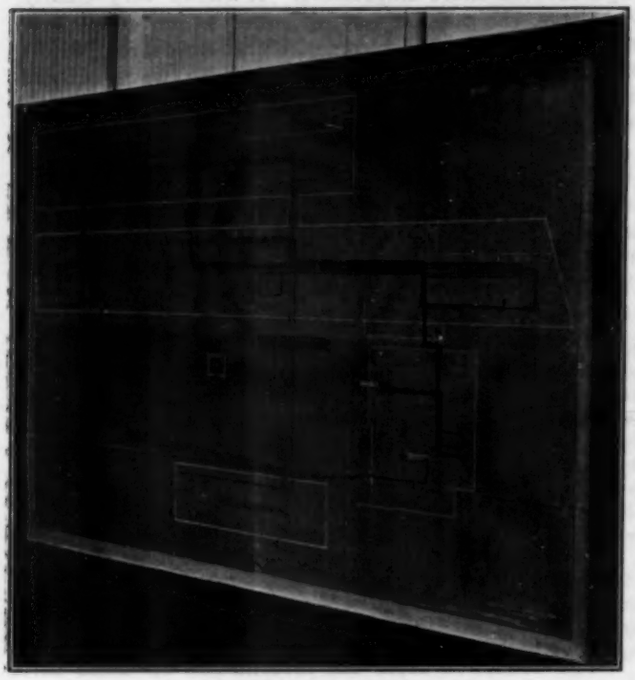


FIG. 1. GRAPHIC DIAGRAM OF WORK GOING THROUGH SHOP

uses the method illustrated herewith to study not only the routing of work, but the way in which orders are received and filled, and also to keep track of the duties of each member of the organization.

In order to see just how the work goes through the shop a blueprint of the building is mounted on a large board, as shown in Fig. 1. In this case, routing of work as it passes through the shop from one department to the next, is traced by means of colored strings drawn around steel pins inserted at different points. This arrangement shows clearly the way in which the work passes through the shop and gives an opportunity to rearrange machines for operation, so as to eliminate crossing of the paths of travel and the moving of pieces unnecessary distances or more frequently than is necessary.

A different type of chart is illustrated in Fig. 2, showing the method of getting the customer's order to the shop order desk. This chart shows how the cus-

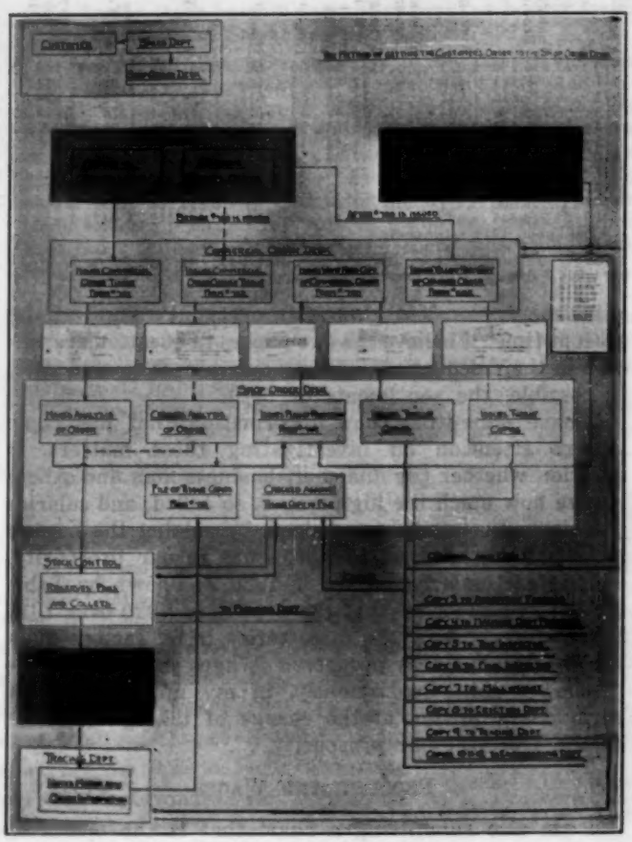


FIG. 2. HOW CONSUMERS' ORDERS REACH THE SHOP ORDER DESK

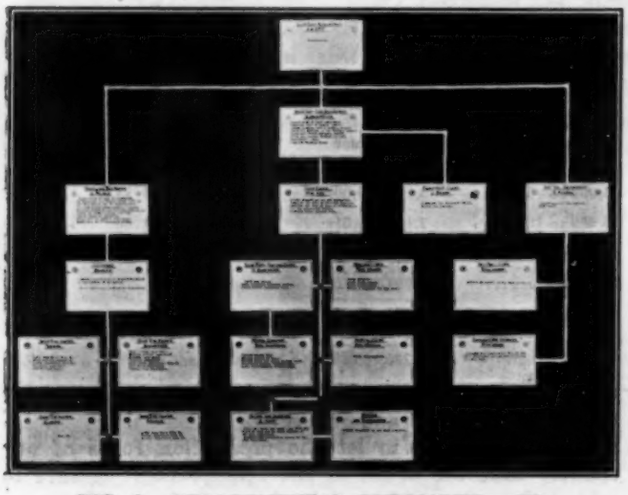


FIG. 3. DEPARTMENTAL PERSONNEL AND DUTIES IN GRAPHIC FORM

tomer's order whether for a complete standard lathe or one involving changes, goes to the commercial order desk, and, through the proper channels, to the shop order desk. It also shows how the orders from here go to the stock control and the tracing department, as well as the distribution of the twelve copies of the order which are issued from the shop order desk.

In order to make sure that the entire personnel of the executive department understands exactly what its duties are, as well as the duties of the others with whom they come in contact, the chart is made, as shown in

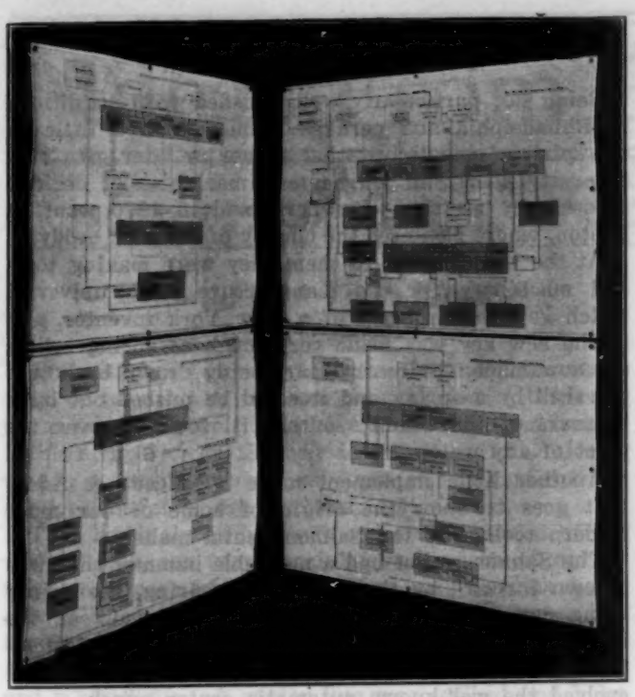


FIG. 4. KEEPING CHARTS IN LARGE BOOK FORM ON LEAVES THAT SWING AND ARE EASILY AVAILABLE FOR CONSULTATION

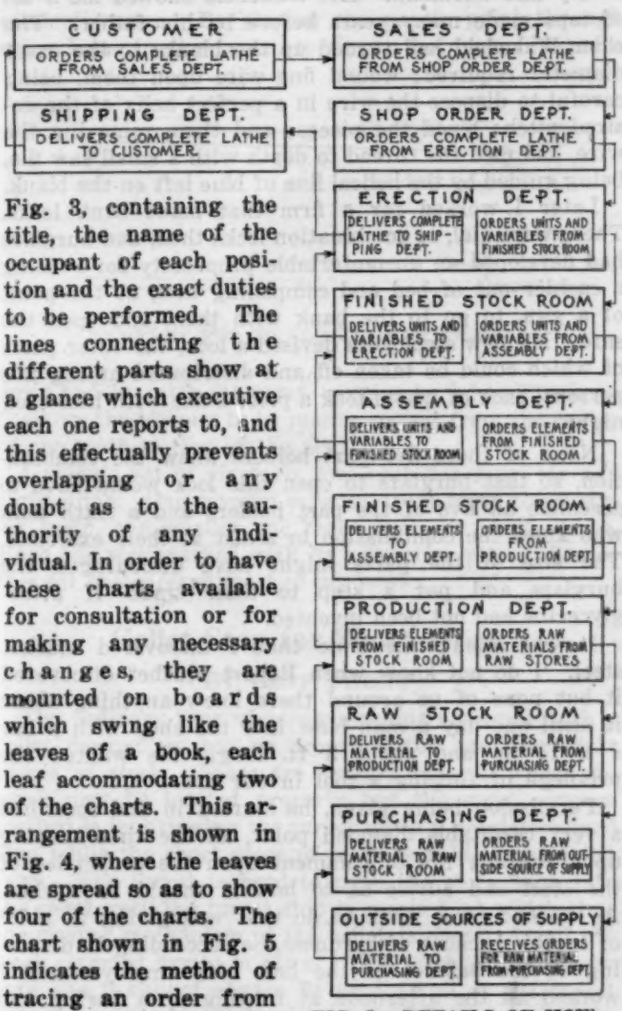

CUSTOMER
ORDERS COMPLETE LATHE FROM SALES DEPT.
SALES DEPT.
ORDERS COMPLETE LATHE FROM SHOP ORDER DEPT.
SHIPPING DEPT.
DELIVERS COMPLETE LATHE TO CUSTOMER.
SHOP ORDER DEPT.
ORDERS COMPLETE LATHE FROM ERECTION DEPT.
ERECTION DEPT.
DELIVERS COMPLETE LATHE TO SHIPPING DEPT.
ORDERS UNITS AND VARIABLES FROM FINISHED STOCK ROOM
FINISHED STOCK ROOM
DELIVERS UNITS AND VARIABLES TO ERECTION DEPT.
ORDERS UNITS AND VARIABLES FROM ASSEMBLY DEPT.
ASSEMBLY DEPT.
DELIVERS UNITS AND VARIABLES TO FINISHED STOCK ROOM
ORDERS ELEMENTS FROM FINISHED STOCK ROOM
FINISHED STOCK ROOM
DELIVERS ELEMENTS TO ASSEMBLY DEPT.
ORDERS ELEMENTS FROM PRODUCTION DEPT.
PRODUCTION DEPT.
DELIVERS ELEMENTS FROM FINISHED STOCK ROOM
ORDERS RAW MATERIALS FROM RAW STORES
RAW STOCK ROOM
DELIVERS RAW MATERIAL TO PRODUCTION DEPT.
ORDERS RAW MATERIAL FROM PURCHASING DEPT.
PURCHASING DEPT.
DELIVERS RAW MATERIAL TO RAW STOCK ROOM
ORDERS RAW MATERIAL FROM OUTSIDE SOURCE OF SUPPLY
OUTSIDE SOURCES OF SUPPLY
DELIVERS RAW MATERIAL TO PURCHASING DEPT.
RECEIVES ORDERS FOR RAW MATERIAL FROM PURCHASING DEPT.

FIG. 5. DETAILS OF HOW ORDERS GO THROUGH THE SHOP

Fig. 3, containing the title, the name of the occupant of each position and the exact duties to be performed. The lines connecting the different parts show at a glance which executive each one reports to, and this effectually prevents overlapping or any doubt as to the authority of any individual. In order to have these charts available for consultation or for making any necessary changes, they are mounted on boards which swing like the leaves of a book, each leaf accommodating two of the charts. This arrangement is shown in Fig. 4, where the leaves are spread so as to show four of the charts. The chart shown in Fig. 5 indicates the method of tracing an order from the customer to the sales department through the different departments of the shop. Beginning at the upper left-hand corner, an order for a complete lathe can be traced through the sales department, shop order department, erection department and the finished stockroom to the other departments of the plant. Following the lines with the arrows, it is easy to trace the progress of the order, and a little careful study of this chart is almost an article in itself concerning the way in which material is purchased, manufactured or stored, and how it is handled from one department to another. With this chart as a basis, it should be easy to prepare similar charts to fit any particular business, and as such charts tend to prevent confusion they are well worth while.

Comparison of American, British and German Machine Tool Exports

By W. H. Rastall
Chief Industrial Machinery Division, U. S. Department of Commerce

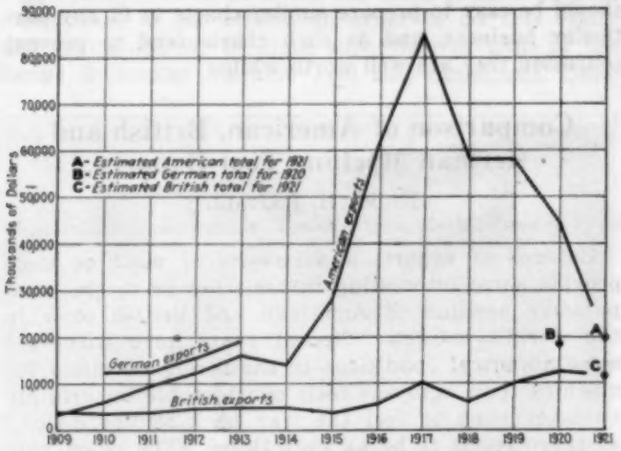
Returns of exports and imports of machine tools provide some interesting information as to the comparative position of American and British tools in the world's markets. Recent years have witnessed some abnormal conditions in the foreign demand for machine tools, and one feels considerable uncertainty on attempting to feel the way back to "normalcy," as there seems to be no such thing. The chart published herewith represents the position in the world's trade of the three most important producing countries during the past twelve years.

In 1913 the American position was rapidly improving, while the British trade made very little progress; the actual British figures being about $3,700,000 in 1909 and $4,900,000 in 1913, as compared with American exports of say $3,600,000 in 1909 and $16,000,000 in 1913. Such returns testify to the splendid engineering represented in American designs and the actual recognition of this superiority in all of the markets of the entire world. Plainly, American manufacturers and exporters have little to fear from foreign competition, because the differences in design, materials and workmanship frequently place the American product in a class by itself, far above all foreign tools.

The curve representing German exports is deceptive, because the classification employed by the German customs authorities includes all metal making equipment and machinery not included in the British and American returns, and the large bulk of the German totals suggests that its tool builders enjoyed a very large trade, which is not the case. Their best market, outside of Europe, during pre-war years, was South America, and their influence in that market was comparatively strong and yet, according to a survey made by one of our American publishing companies, British manufacturers had supplied about 42 per cent of the tools, American 39 per cent and German 12 per cent which represents more accurately the estimate one forms of the comparative trade of the several nationalities after traveling through overseas markets. Because of this difference in classification, it is important to note, not the value represented by the curves but their slope. The German trade increased from about $12,400,000 in 1910 to $19,500,000 in 1913, a gain of 57 per cent, while the American gain was 166 per cent during the same period. Obviously, American interests have every reason to be perfectly satisfied with this pre-war record.

Confusion resulting from the declaration of war in 1914 caused a temporary set back in American exports, and the German business was completely destroyed, not to revive until after the armistice late in 1918.

The present problem is introduced by the remainder of the chart. British tools usually differ greatly from the American types, and the world's markets for such equipment have been inadequately supplied for some years. Also the increase in cost per tool would cause the curve to rise, in spite of the fact that the values have been corrected for fluctuation in



AMERICAN, BRITISH AND GERMAN MACHINE TOOL EXPORTS

exchange and are expressed in dollars, not pounds. But at any rate the American curve is falling very rapidly; the British is rising; while the German return for 1920 is approximately the same as for 1913 and about $19,000,000. The probability is that the American total for 1921 will approximate $20,000,000.

Decline In British Exports

British total exports are decreasing rapidly and for all of 1921 will approximate less than three million pounds or say twelve million dollars. This trend suggests that, although one would expect that the demands for British style tools had not been adequately supplied for years, and the corresponding market for American style tools had been over supplied, the influence of the latter is still powerful enough to prevent the development of the market for the former, viz., the simpler and less expensive types of equipment—a circumstance that encourages more aggressive selling on the part of Americans.

In considering the comparative position of American and British machine tools in the markets of the world, it should be remembered that for many years America has shipped great quantities of tools to the United Kingdom while the trade in the opposite direction has not exceeded a hundred thousand dollars in any one year—a condition that is not to be attributed entirely to the workings of the tariff. But following the armistice there has been a strong tendency for the British imports of American made tools to recede from the very high levels of war days. In August, 1920, British imports still exceeded their exports, but there has been a very rapid decrease in the volume of this business, and it has reached very low levels which in itself has a most important influence on the American returns; for even as late as 1920 the United Kingdom absorbed 25 per cent of the total American exports of metal working machinery.

Reminiscences of an Old-School Machinist

By R. Thomas Huntington

Being not particularly well satisfied with conditions in Philadelphia and perhaps imbued with a little of the spirit of wanderlust that sooner or later gets hold of pretty nearly all journeyman machinists, I decided to seek my fortunes elsewhere, and in 1870 went to Boston, where I entered the employ of Meade & Addy.

At the time I went to them they were making tools and machinery for the manufacture of a universal watch key, the property of a New York inventor.

The new key was made very much as spring collets are now made, the central part being drawn back into the shell by a spring and it could be pushed out by a pressure of the thumb, so that it would fit over the pivot of any watch.

Another little implement made by Meade & Addy, that goes to show the origin of some of our more modern tools, was the Salmon dental mallet.

The Salmon mallet had a moveable hammer that was thrown forward by the action of a spring, the spring being compressed and released by movement of the handle. Several years later I showed one of these mallets to Cyrus Carleton, of Brown & Sharpe, and he evolved the well-known automatic center punch.

Meade & Addy also made the first Peabody rifle, the parts being made by a man named Wakefield, who was a very fine workman. Mr. Wakefield showed me a set of taps made many years before by his father. The elder Wakefield had turned up the blanks to the exact diameter required; wound fine wire upon them, being careful to dispose the wire in a perfect helix of the desired pitch; blued the pieces; and then, removing the wire, had filed the thread to depth with a small saw file, being guided by the helical line of blue left on the blank.

Later I worked for a firm that made bank locks. There were dial, or combination locks then, and burglars had developed an uncomfortable propensity for rousing a cashier out of bed and compelling him, at the point of a gun, to go to the bank with them and open the safe. My new employers devised a lock, the outer parts of which could be taken off and distributed among five persons, each of whom took a piece home with him each night.

None of these five part holders knew the combination, so that burglars to open this lock would have to assemble all five of the part holders and a sixth man who knew the combination to assist at their exercises. The size of the parts might have discouraged the burglars and put a stop to their trade—if nitroglycerine had not been invented.

It was about this time that I discovered mushet steel. I do not know when Robert Mushet discovered it but none of us around there knew anything about it until one day a man blew into the shop with a bar ¼ x 1¼ in. and about 3 ft. long. He wanted the privilege of forging a tool in our fire.

Permission being given, he started in and soon had a very cerditable diamond point, all the time keeping up a running fire of comment upon the properties of the steel and advice as to how it should be worked. As we had some work to do that was giving us a lot of trouble because of hardness, he succeeding in disposing of the balance of the bar. My employer and I worked all the afternoon at forging up a boring tool and when we finally got one finished there wasn't anything left of the bar.

Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

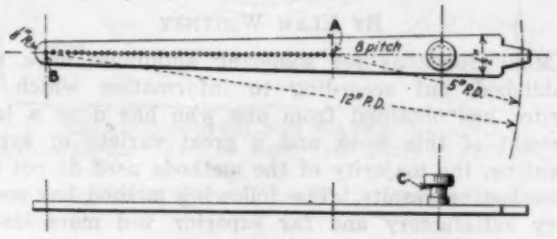
Drawing Gear Teeth Rapidly

BY E. C. BARBER

The article by Homer S. Trecartin under the above title, on page 481 of the *American Machinist*, brings to my mind a little tool that I have found useful and which I think superior to the one described by him. I saw one in a drafting room that I visited and copied it, so cannot claim it as my own idea.

The sketch shown herewith gives a clear idea of the tool. I laid out very carefully on a piece of an old triangle, a tooth for an 8-pitch gear, using a pitch diameter of 8½ in. as it was the mean diameter between two limits I had chosen—5 and 12 inches.

The tooth shape was formed by the use of a knife and a small file. A center line was scribed and holes drilled at B and at intervals of ⅛ in. between *B* and *A*. With a needle point through the hole at *B* it would be right for drawing in the teeth of a gear having a 12-in. pitch diameter. By placing the needle point through other holes in the series, teeth can be drawn in gears



TEMPLET FOR DRAWING GEAR TEETH

down to 5-in. pitch diameter, varying by ½ in. The knob *C* allows the templet to be readily moved from the center of one tooth to that of the next.

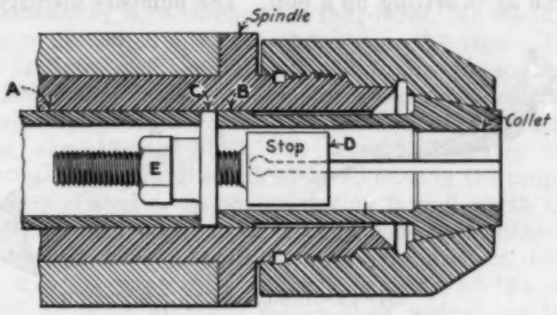
I made a set of six tools, two each for four, six and eight pitch. One covered a range from forty to ninety-six teeth, the smaller one from twelve to forty teeth. Each one was marked with its respective pitch. So far this set has covered most of my work.

Collet Stop for Short Work

BY GENE PHELPS

The ordinary type of screw machine equipped with a collet mechanism has no provision for handling short pieces of stock. There are several ways in which the work may be located properly but the most common method is by bringing the turret up to a pre-determined stop while the short piece of work is held in the collet jaws. The turret is used to push the stock back into the collet until the turret stop is reached, at which time the closing mechanism of the collet is operated and the work clamped firmly in place. This method is not very safe and it cannot always be used as all of the turret faces may be supplied with tools. It is possible to arrange a stop rod from the rear of the spindle and locate the work against it. An arrangement of this sort however is troublesome and usually not very satisfactory.

It is possible to make up a special stop which is self-contained and easily applied to the majority of turret lathe spindles. The sectional view shown here is taken



COLLET STOP FOR SHORT WORK

through the center line of the spindle. The closer *A* is generally against the end of the collet at *B*. In using the stop the collar *C* is interposed between the closer and the end of the collet as indicated. The stop is made up from steel with an end on it as shown at *D*. The other end is threaded so that it passes through the collar and is held in position by means of a check nut at *E*. This arrangement provides a positive stop for short work and its advantages are that it can be easily applied to any standard type of screw machine.

Avoid Danger When Drilling in the Lathe

BY G. E. CLIFFORD

Where drilling is to be done in the lathe and the available equipment consists of the conventional "T" drill holder, there is danger lurking for the operator who does not take precautions.

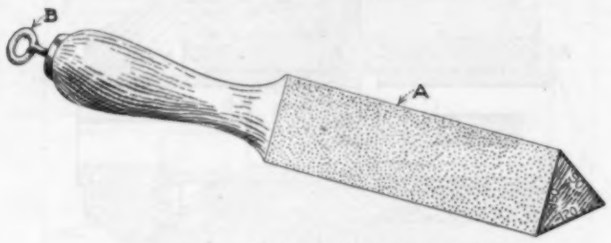
It is a matter of common knowledge that when a through hole is drilled the drill has a tendency to catch and draw in when pricking through the farther side of the work. This drawing-in effect may be, and often is sufficient to let the holder drop off the tail center, although the operator may be able to oppose this tendency by force. If, however, he is not able to do this, his hand is in a position to be badly hurt, which is of more importance than the breaking of the drill and the spoiling of work—the inevitable consequence.

All this is easily avoidable. Allow the handle of the drill holder to slide along the back of a tool secured in the toolpost, this latter acting as a limit stop for the holder handle. By moving the carriage the post may be kept in very slight advance of the handle as the drill is fed into the work. Then when the drill pricks through and starts worming in, the toolpost stops it and breaks off the chip before any damage may be done to tool, work, or man.

An Abrasive Block With Three Sides

By W. Burr Bennett

There have been many ideas advanced in the past for handy pencil sharpening blocks for draftsmen's use but practically all have involved the use of sandpaper or emery cloth and used only on one or at the most two sides of the block. The sketch herewith shows a block in successful use, made with three sides as shown at *A* and with a nicely rounded handle fitted with a hook or small eye as at *B*. The block is made out of any wood and can be planed and turned up by a patternmaker. Instead of using sand-paper or emery cloth glued to the side of the block, the block is prepared with hot pattern makers' glue and then three grades of Norton alundum, Nos. 90, 120, and 150 are applied to the hot glue the same as in setting up a buff. The numbers identifying



THREE-SIDED ABRASIVE BLOCK

the three grains are stamped on the end as shown as a little refinement. The device is very durable and cheap. Most all modern machine shops today are using buffing operations and therefore will have abrasive on hand.

Aero Cylinder Depth Gage

By Douglas P. Muirhead
Glasgow, Scotland

The Aeronautical Inspection Department (British) never used a gage of the type described by Mr. McIntosh, on page 655, Vol. 54, of *American Machinist*, for inspecting aero cylinders. A sketch of the gage actually used is shown in Fig. 1.

A is a steel body containing the tapered plunger *B*

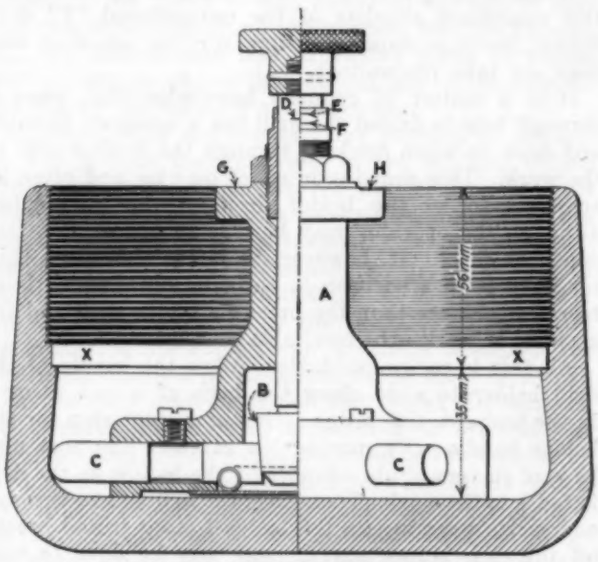


FIG. 1. THE DIAMETER GAGE IN THE CYLINDER

which controls the movement of three plungers *C* set at 120 deg. to each other.

The high and low limit for chamber diameter is shown by the position of the line *D*, in relation to *E* and *F*. The 91-mm. portion is not important and was not held to fine limits; it was therefore found easy to check this by means of a straightedge and the step portions at *G* and *H* when the gage was resting on the bottom of the combustion chamber. The particular dimension is the 35-mm. portion, which was checked by means of the gage shown in Fig. 2. This gage rested on the liner landing at *XX*, Fig. 1, on the ground surface *A* and the knurled head *B* could be partly rotated, the grub screw preventing further movement. The limits were marked by lines as at *C*, and a third line on the body completed the gage. The spring *D* tends to take up any slack in the screw.

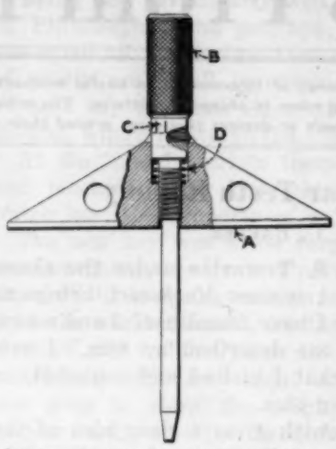


FIG. 2. THE DEPTH GAGE

Soldering Aluminum

By Elam Whitney

Many formulas for soldering aluminum have been published, but according to information which the writer has obtained from one who has done a large amount of this work and a great variety of experimenting, the majority of the methods used do not produce lasting results. The following method has proved very satisfactory and far superior and more lasting than any previously tried.

Use a pure aluminum soldering "iron" which can readily be made from a piece of $\frac{5}{8}$ or $\frac{3}{4}$-in. round or square aluminum; tin the parts to be soldered with a composition of 81 per cent tin, 16 per cent aluminum and 3 per cent copper. This is not a new composition but in the proper method of preparing it lies success.

After fusing the copper add the aluminum a little at a time while continually stirring with a piece of iron, then add the tin and also a small portion of tallow; after the ingredients have all been added care should be used so as not to overheat.

Lubricating and Cooling Roll Journals

By M. E. Duggan

The method of lubricating roll journals is just the same as it was thirty years ago when I was employed at the old Bridgeport Steel Mills, with this one exception.

Thirty years ago, the lubricating grease was applied with a scoop shovel. The man who could hit the neck of the roll with a scoop full of grease at five paces, was considered to be a valuable employee and in line for promotion to the position of boss roller. Everything, including the operators, was covered with grease, ex-

cepting the roll journals, where it was intended the grease should be. There were several who received honorable mention, but only two were made boss rollers during the three years I was employed at the mills. Now a shingle is used instead of a scoop shovel.

In the Fig. 1 is shown a bearing fitted with two containers or drawers of cast brass. One is for grease for lubricating the neck or journal, the other for water for cooling the journal. The circular bottom of drawer *A* is perforated and through these perforations the

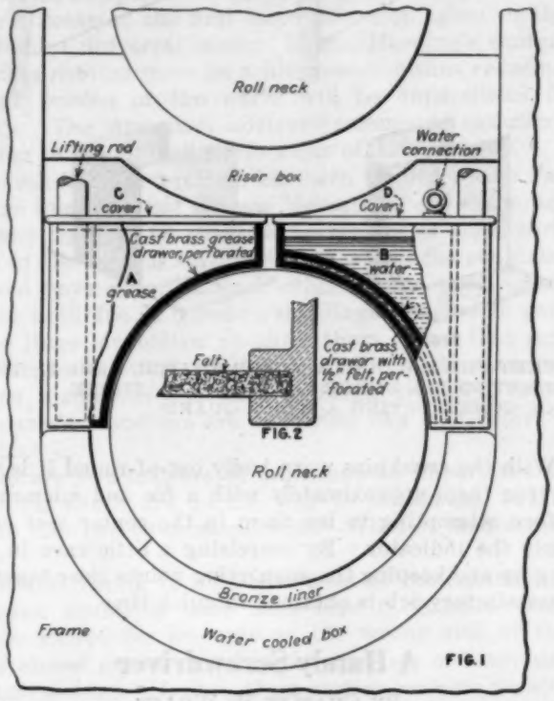


FIG. 1. BEARING FITTED FOR WATER COOLING AND LUBRICATION. FIG. 2. HOW THE FELT IS FITTED

grease is fed onto the roll journal. Drawer *A* has a cast cover *C*.

The other drawer *B* is cast with sides and ends and has grooves in each side, as in Fig. 2, into which felt is fitted and securely held. The felt is perforated sufficiently to allow the water to pass through and onto the roll journal, at the same time serving as a screen to prevent, as much as possible, the sand in the running water from reaching the neck or roll journal.

The grease drawer *A* can be removed, cleaned, refilled and returned to its place. The water drawer *B* can be taken out, cleaned, and if necessary, the perforated felt strainer removed and a new one put in its place.

A rubber hose can be attached to the water connection in the cover.

Sheet Metal Work for Machine Designers

BY JOHN L. ALDEN

Sheet-metal work, or "tinsmithing," is something outside the experience of the average mechanical draftsman or machine designer. A knowledge of the possibilities of sheet-metal work and familiarity with the more common construction is often of the greatest practical value. At some time or other nearly every designer is called upon to lay out gear guards, tanks, drip pans, exhaust hoods, and other sheet-metal details. Unfortunately, a large number of otherwise capable men are unable to design economical pieces of sheet-metal work and are plainly unfamiliar with the relatively few and simple tools of the tinsmith.

Press-formed sheet metal parts are well understood by most draftsmen. A great many constructions are possible, however, which will accomplish the same results as a stamping, and yet be within the range of the hand tools of a tinshop. In this way, the advantages of lightness and strength of a stamping may be obtained when only small quantities of a part are wanted. Many times, a sheet-metal part is more suitable than a casting. It is usually lighter, and quite often cheaper, if only one or two pieces are needed. A very good example of the substitution of sheet metal for cast iron is the motor starting-switch bracket shown in Fig. 1. The bracket is suspended from the under side of a tank on the machine, and the switch is mounted on the face of the bracket by bolts through the four holes. No machine work is needed on either the bracket or the tank. The part is light, stiff, and strong and fulfills its purpose admirably. A bracket of this form has extraordinary strength when intelligently proportioned. Only a trial using, say, 16-gage steel, will serve to convince the skeptical of the rigidity gained by employing the proper flanges and angles. A demonstration is well worth the trouble; it will open the designer's eyes to a hitherto unsuspected field of application. To the student, also, such a demonstration is valuable evidence of the superior influence of form rather than weight on the strength and rigidity of a part. Correct form is vital.

A bracket of the form shown in Fig. 1 is weakest along the junction of the flange and shelf. It will fail under load, not by rupture of the metal, but by opening out the flange as at *A*, Fig. 2. It is therefore necessary to securely fasten the flanges to the supporting member carrying the bracket, placing screw heads in the flanges as near the shelf as possible. In Fig. 1, the side flanges greatly assist the crossflange at the top.

The scope of this article does not cover the tools for sheet metal work except to state their general purpose. A catalog of such tools will show their construction clearly, and a visit to a tinshop will give a better idea of their operation than would any description. Hand shears are either straight "snips" or "circle" shears with curved points. Power shears are slitting shears, circle shears, squaring shears, etc., and their functions are well described by their names. The hand or power brake is a machine for folding or turning a flange or edge on a straight sheet. The flange is usually not folded through a greater angle than 135 deg. The folder is a similar machine for narrow sheets and light work. Rolls are used for forming cylindrical work and parts of cylinders.

The materials most commonly employed are black and galvanized steel in 30 x 96-in. or 36 x 96-in. sheets. Tanks and other exposed work should be galvanized, both for durability and for ease in soldering. Guards, brackets and parts to be painted should be of black iron, as paint does not adhere well to galvanized metal. Sheet iron and steel are gaged by the U. S. Standard sheet metal gage, and the numbers most commonly used in mechanical work are those from Nos. 24 to 16, by even numbers. If much hand cutting and punching is to be done, it is well to avoid heavier gages than No 20. In specifying sheet metal, many firms employ the decimal equivalents of gage numbers to avoid confusion on the part of inexperienced mechanics and draftsmen.

Joints are made with black or tinned rivets, stove

bolts, solder, or some method of seaming. Water-tight joints must always be soldered. Riveted and soldered joints are the rule for gages heavier than No. 16. Straight parts are flanged on a brake for riveting and curved parts are notched and bent for most heavy work, and hammer flanged on light gages. In this connection is should be said that a great deal of time and money can be saved by knowing when and how a piece should be flanged. Fig. 3 shows a worm guard about 8 in. high. A cheap construction is obtained when the ears for attaching the guard are flanged as at *A*. Since they do not extend past the straight part of the guard, they may be bent in a folder without stretching. The ears of form *B* must be attached as a separate piece or else the metal at *X* must be stretched by hand hammering on a stake to form the flanges. The construction shown at *C* is still cheaper, being bent on a brake without stretching or rolling.

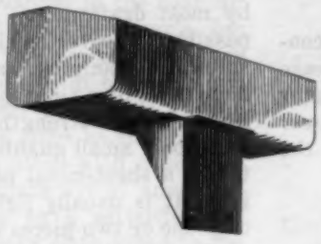


FIG.1

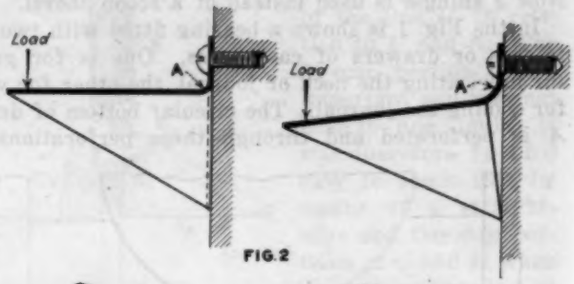


FIG.2

FIG.3

FIG. 1. SHEET-METAL BRACKET FOR HOLDING A MOTOR SWITCH. FIG. 2. THE ACTION OF BENT SHEET METAL UNDER LOAD. FIG. 3. THREE METHODS OF CONSTRUCTING A WORM GUARD

For stiffening sheets, band iron or light rolled angles are used. Turned flanges, hemmed edges and wire edges are common constructions. The wire edge is often used for appearance and because of the smooth edge it presents. A "thick edge," or beading machine is usually used for forming the flange for a wire edge.

Before attempting the design of much sheet-metal work, the draftsman should spend several hours in an up-to-date tinshop. A little personal experimenting with the brake, rolls, and shears will teach the elements of sheet-metal working to any observant draftsman. If in doubt as to the forming of a piece, the making of a paper model will be found to be of the greatest help. Paper and sheet metal behave in much the same way and if a one-piece paper model can be made, its metal counterpart is almost certain to be capable of economical production. The draftsman will find it a valuable accomplishment to be able to make understandable free-hand perspective or isometric sketches. Even the best sheet-metal drawing is hard to understand and a paper model, or a judiciously shaded perspective sketch is of great assistance to the mechanic.

Re-Turning the Pins of Multi-Throw Crankshafts

BY R. MCHENRY

In the absence of special machinery the usual procedure in re-turning the throws of multi-cylinder engine shafts is first to make a pair of offset centers, which are clamped to the ends of the shaft; often entailing more time and labor than the job itself. A much simpler way, which has proved entirely practical is to hold one end of the shaft off-center in the lathe chuck and place one of the crankpins, near the opposite end, in the center rest. The work is then centered accurately by applying an indicator to the nearest parallel crank.

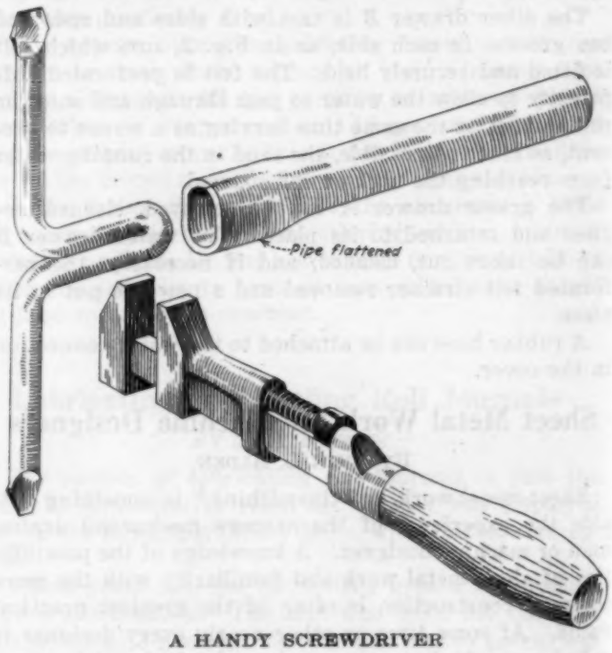
If the chucked part is not flanged, or is of small diameter, a collar or cast-iron block with hole and set-screw may be fitted over it to enable the chuck jaws to grip it properly.

With the crankpins worn badly out-of-round it is well to true them approximately with a file and micrometer before attempting to lay them in the center rest or to apply the indicator. By exercising a little care in setting up and keeping the supporting points close together a satisfactory job is obtained in quick time.

A Handy Screwdriver

BY CHARLES H. WILLEY

From a piece of ⅜-in. drill rod I have made a very handy double-ended screwdriver, having a large blade on one end and a smaller one on the other. The sketch



A HANDY SCREWDRIVER

shows how the tool is used. A piece of flattened pipe or a monkey wrench serves as the handle.

EDITORIALS

After Naval Armament Limitation—What?

JAPAN'S acceptance of the Hughes 5-5-3 ratio assures the success of the first important step taken in the direction of universal peace. If Mr. Harding's conference does nothing more its achievement in thus reducing the tax burden of the world will be unparalleled in history. The American advisory committee calculates a saving to the United States alone of $200,000,000.

A much knottier problem has been tackled in the Far Eastern question, but surface indications are encouraging and point to an eventual agreement of some sort. Much of the mutual suspicion with which the countries involved have regarded each other in the past, seems to have been due to misunderstandings fostered in part by the jingo journalism of all of them. Now that representatives with an earnest desire to find means of gaining a common end have gathered around a table, the misunderstandings are dissolving like mist before a hot sun.

Here are two matters of transcendent importance to the world which are on the way to settlement, but is this all that can be accomplished? What of land armaments?

It is interesting to note that most of the continental European countries have been able to balance their budgets except for amounts on the wrong side of the ledger almost exactly equal to the expenses of maintaining their armies. If, then, these armies could be greatly reduced or dispensed with altogether, there would be a good chance of putting the greater part of Europe on a stable financial footing.

It seems unlikely that much progress in this direction will be made by the present conference, but if this surmise turns out to be correct, then by all means let us arrange for another one to be held soon at which the questions of land armament reduction and economic stabilization can be thrashed out. Think it over!

Poughkeepsie's Relief Work

ONE of the results of the unemployment conference is shown in Poughkeepsie, N. Y., which had 4,500 persons idle and found business slowing up. The Chamber of Commerce got busy and as a result nearly 3,000 of those idle from the shutting down of other plants, have been taken in by the shops now running.

This has been made possible by a stimulation of local business through a "no profit" sale of goods made in the city. The leading store conducted this sale which included clothing, agricultural implements, furniture, hardware, supplies, cigars, candies, textiles, automobile supplies, etc. Both manufacturers and retailers sacrificed all profit on the goods to stimulate buying and so enable the plants to operate.

Municipal work has also been ordered, which will help find employment for the remainder. The work of assisting where necessary can be centralized, using existing agencies so as to minimize overhead expense.

A joint note of $5,000, signed by fifty business men, has established a fund from which loans not exceeding $100 are made to essential breadwinners to enable them to maintain or rehabilitate homes. Every indication of charity has been removed from the relief work by placing orders for food, coal, clothes, etc., with local merchants to deliver in the usual manner.

An interesting feature is that the major number of cases of relief are in the white collar class. This is because their income did not increase so that they could save enough to carry them over the depression. The fact that the workers do not need help rather gives the lie to the statement that none of them saved when wages were high.

Poughkeepsie is to be congratulated in pointing out a way for other cities to follow. Co-operation between manufacturers and merchants, through the Chamber of Commerce, seems to be a logical first step in the work pointed out by Mr. Hoover.

Fitness for the Job

ONE of the great problems in running any kind of a business is to get the right man for each job. If the labor unions, in addition to or instead of being defensive and offensive organizations, would also become constructive to the extent of supplying men of the different grades needed, many of their troubles would disappear. If we could be sure of getting a good milling machine man when we asked for one, there would be much more hope of getting along without friction in the shop. This is being done to some extent in a few trades and is a step in the right direction.

Unfortunately, however, the need for suitable men is not confined to the shop, and we are all too apt to find misfits and incompetents in the manager's chair. As Ernest F. DuBrul pointed out in a recent article in the *American Machinist*, these men are more of a handicap to industry and to the community than the poor workman.

The day has gone by when a community or an industry can afford to have anyone who happens to have the necessary capital start a business. Unless the capital is managed by those who understand the business, who appreciate the responsibilities as well as the privileges of leadership, a new industry in a town may be a liability instead of an asset.

The successful manager of today must be far better equipped in every way than his predecessor of the past generation. He must not only understand business but he must understand the psychology of men and the methods of handling them. Real leadership must take the place of the driving tactics of a few years ago.

Management today is a real man's-size job in every particular. Those who are fitted for it secure real co-operation and economical production. Those who cannot meet this test must gradually drop by the wayside. Fitness for the job of managership does not depend upon family or financial resources but briefly on the ability to deal fairly and sympathetically with workers and customers alike. It is becoming a more difficult but a more necessary profession every year.

Shop Equipment News

Clay Automatic Machine Operator

The Key Boiler Equipment Co., 27th and McCasland Ave., East St. Louis, Ill., has recently placed on the market an air-operated automatic "operator" for bolt cutting and nut tapping machines.

As applied to a bolt cutting machine, the "operator" clamps the work, feeds it into the dies, opens the dies

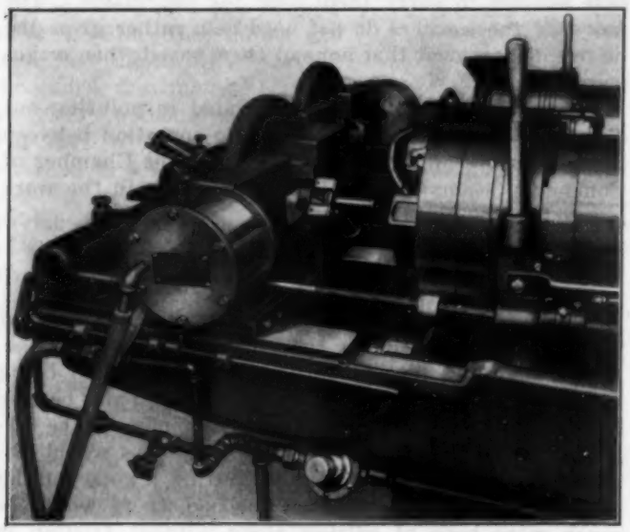


FIG. 1. MACHINE "OPERATOR" WITH FEED AND EJECTOR ON A BOLT CUTTING MACHINE

after the thread has been cut, returns the carriage to its starting position and closes the dies for the next cut, all by the movement of two levers, and during these operations no attention is necessary.

If the machine is provided with a lead screw, it is possible to cut a thread having a continuous lead on the opposite ends of a bolt, or if the part between the threads is of a diameter no greater than the root of the thread one end may be threaded, the nicked down part jumped and a thread of continuous lead cut on as much of the remaining part as protrudes from the jaws of the vise.

For threading ordinary square or hexagon head bolts from ⅜ to 1¼ in. in diameter, a special feed and ejector as shown in Fig. 1 can be furnished.

In addition to the automatic motions above described the finished bolt is ejected from the holder and thrown clear of the machine. When another bolt is pushed in from the magazine and the starting lever pulled, the cycle of automatic movements is repeated.

In Fig. 2 is shown an automatic "operator" applied to three spindles of a nut tapping machine. An air operated piston holds the spindles up when the taps are full. Mechanism that controls the rise and fall of the spindles operates the device for feeding the blank nuts into the tapping position. As soon as a nut is tapped the spindle and tap are raised carrying the tapped nut on the tap. Another nut is fed into position and the tap lowered into it. When the shank of the tap is filled with tapped nuts the spindle rises and remains in the raised position ready for the attendant to remove and empty the tap and replace it.

The principal parts of the regulating and feeding mechanism can be arranged to take care of all sizes of nuts within the capacity of the machine.

Both the bolt threading and nut tapping attachments can be applied to practically all makes of machines.

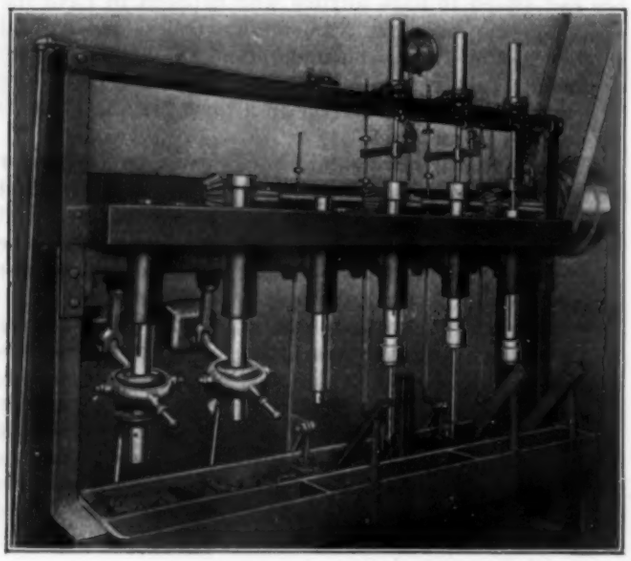


FIG. 2. MACHINE "OPERATOR" APPLIED TO A NUT TAPPING MACHINE

United States Electric Company Rivet Heater

The United States Electric Co., New London, Conn., has placed on the market a portable electric rivet heater designed for use in shipyards, boiler and car works, steel building construction or wherever structural steel work is being done.

The machine is regularly built with two, four, or six electrodes for manual operation, and the larger sizes can be furnished when desired with an automatic movement for carrying the rivets between the electrodes and discharging them when heated.

The automatic movement consists of a pair of intermittently rotating skeleton dials so constructed as to carry the rivets forward in pairs, and cams for opening and closing the electrodes in conjunction with the movement of the dials; the whole being driven by a continuously running motor, so that all that is required of the operator is to see that the dials are kept filled with rivets to be heated.

Only the lower electrodes of each pair are connected with the terminals of the low voltage coil, the upper one being merely a connecting link between the two rivets, so that each pair of rivets in the machine is in series and current passes only when both rivets are in place.

In the manually operated machine the electrodes are opened by conveniently located pedals and are closed by the action of heavy coil springs; thus insuring proper electrical contact.

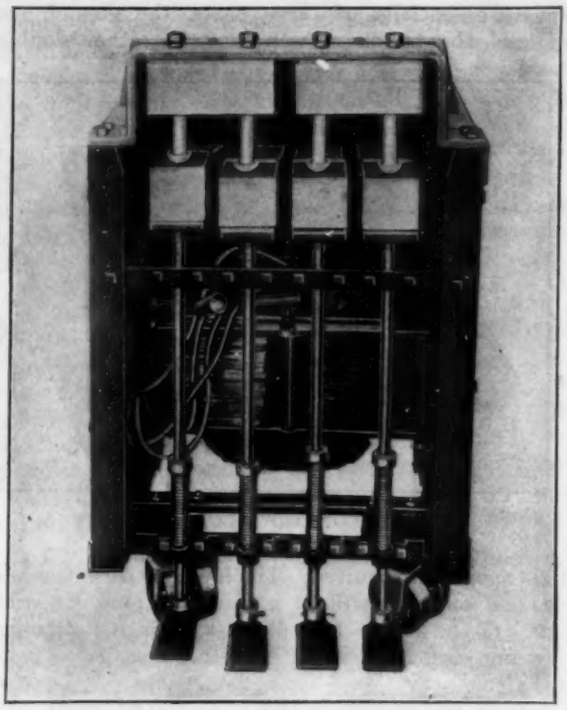


FIG. 1. FOUR ELECTRODE MANUALLY OPERATED MACHINE

The primary coil of the transformer is built up from flat strips of copper welded to the terminals, and the magnet core is of laminated soft iron.

The machines are strongly and compactly built and are provided with casters upon which they may easily be rolled from place to place as required, while eyebolts in the frame provide for picking them up with the yard or shop crane when that means of transportation is available.

They are regularly furnished for 220, 440, and 550-volt, 60-cycle, single-phase current, or may be specially constructed for other voltages and frequencies when so ordered. Only alternating current can be used.

The machines are 33 in. in height, 22 in. in length, and vary in width according to the number of electrodes.

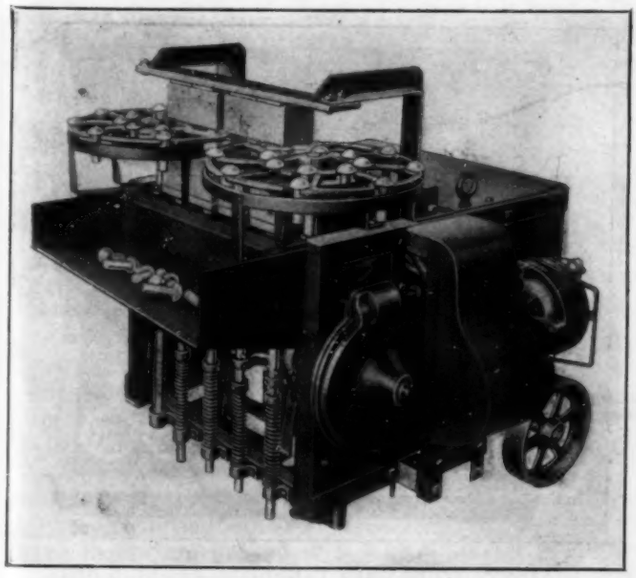
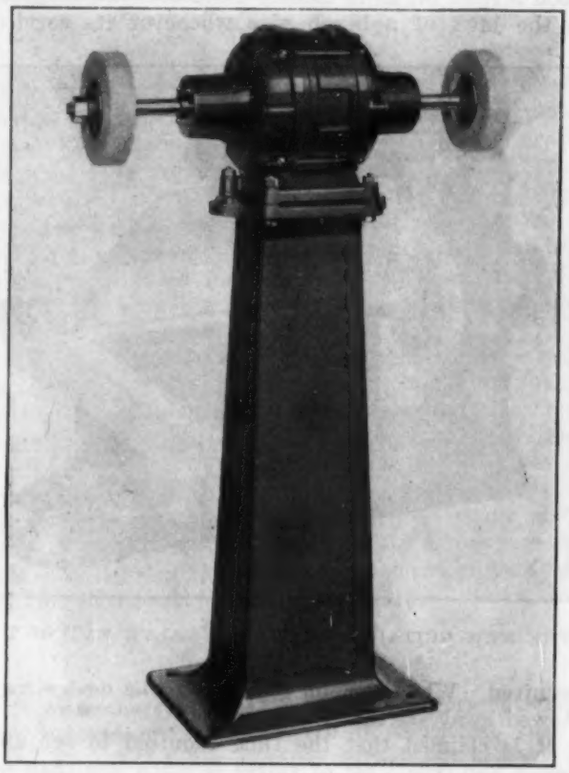


FIG. 2. FOUR ELECTRODE AUTOMATIC MACHINE

Dimo Electric Tool Grinder

The machine shown in the illustration is the Dimo electric tool grinder which has been placed on the market by the Luther Grinder Manufacturing Co., Milwaukee, Wis. This tool grinder is intended for use in manufacturing or repair shops where electric current is available. As the machine is motor driven, it can be placed in any desirable location. The motor is dust proof, and runs in S. K. F. bearings. The arbor is of rigid construction and is long enough to allow plenty of space between the bearings and the wheels. The wheels are Dimo-grit wheels made especially for use in this company's machines. The grinder may be furnished with either a high or low pedestal, as required, and can also be furnished with tool rack and guards at a slight additional cost.

The machine is built in five sizes with single phase



DIMO ELECTRIC TOOL GRINDER

motors for 110 or 220 volts and in five sizes with two or three phase motors for 110, 220 or 440 volts. The machines can be furnished for belt drive if desired.

New Britain Adjustable Valve Facing Tool

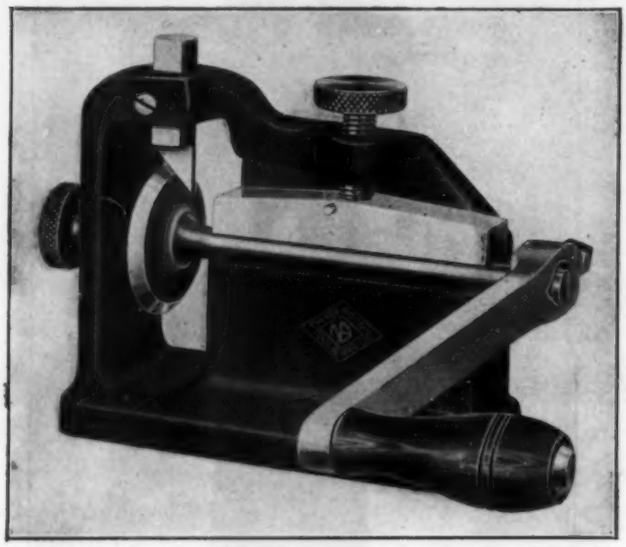
The New Britain Tool and Manufacturing Co., New Britain, Conn., has placed on the market a device for resurfacing the valves of automobile engines. It is entirely self-contained, needing no accessory bushings or other losable parts. It will handle valves of any commercial size of stem without other adjustment than the turning of a screw, and is designed primarily for the use of the individual automobile owner who wishes to make minor repairs upon his car himself.

As may be seen in the illustration, the stem of the valve to be resurfaced rests in a long V-groove that is machined in the body of the device and is held down by a flat steel shoe that bears on top of the stem, thus holding

it in a three-point bearing that extends nearly the full length. The valve is rotated by means of a crank handle which is setscrewed to the outer end of the stem. Pressure to hold the stem in the bearing is applied by means of the knurled screw above and may be nicely adjusted to allow the valve to rotate freely but without shake or chatter.

A fixed cutter of high carbon steel is held in a vertical position above the valve by means of a small headless setscrew. The edge of the cutting tool is accurately ground to the original angle of the valve to be resurfaced, and the tool may instantly be removed for resharpening or for the substitution of cutters of other angles.

The upper surface of the valve abuts against the point of the knurled screw to the left, by means of which the valve is fed to the cut. The device may be permanently fastened to a work bench by means of wood screws or, as is usually more convenient, grasped in the jaws of a bench vise whenever its service is required. When the job is finished, the device may be stowed away on the shelf.



THE NEW BRITAIN ADJUSTABLE VALVE FACING TOOL

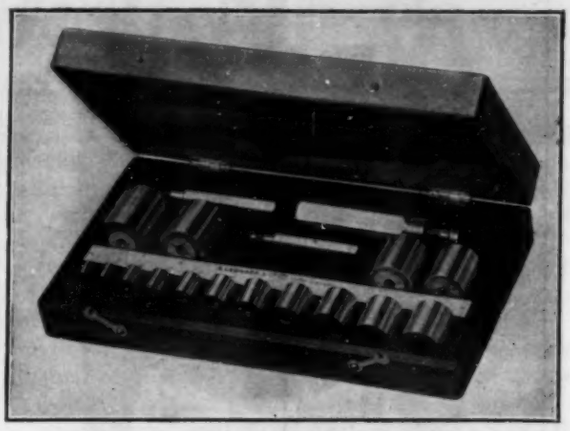
It is claimed that the time required to set up the device and true a set of valves is much less than would be needed to accomplish the result by any other method.

Coats "Leonard" Gages

The Coats Machine Tool Co., Inc., 110 West 40th St., New York, N. Y., is placing on the market a line of Leonard gages. The standard plug gages are fitted with renewable heads, making replacements possible at a minimum cost. They are made of hardened steel, and are guaranteed accurate to within 0.0001 in. of nominal size. They are put up in two sets, the No. 1 set being illustrated herewith.

The No. 1 standard set comprises 14 sizes from ¼ to 1¼ in. Any special combination of sizes can be supplied to order. The four smallest sizes are usually solid with the handle. The No. 2 standard set comprises the sizes from 1⅜ to 2½ in. The plugs rise in size by ⅛-in. steps up to 1 in., by ¼-in. steps from 1¼ to 3 in., and by ½-in. steps from 3 to 6 inches.

Limit plug gages of the renewable type can be supplied from stock in various sizes and limits. The gage consists essentially of three parts, the go-end, not-go end, and the handle, which may be either double or single ended, as required. The handles are interchangeable, and one size will fit a range of plug sizes. The plugs are stocked to Newall class A or B limits in the following sizes: ¼ to 1 in. in ⅛-in. steps, 1⅛ to 2 in. in ¼-in. steps, and 2¼ to 6 in. in ½-in. steps. It is possible to supply any size in English or metric units to any given limits, the maker states. The gages can be supplied in sets in large cases, or singly in individual cases.

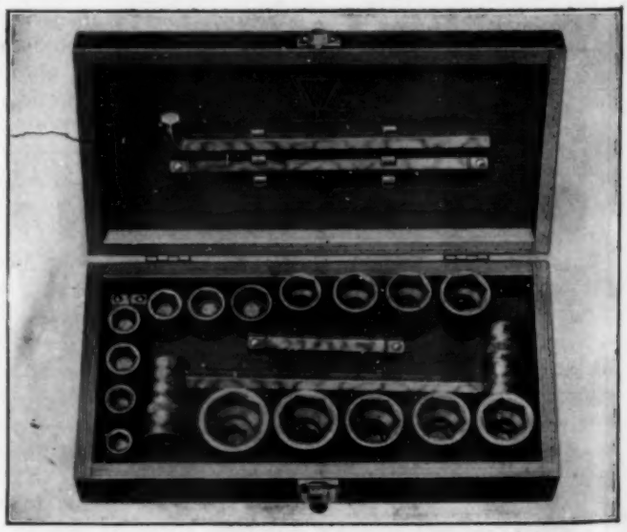


COATS "LEONARD" PLUG GAGE SET

Standard ring gages are made from ¼ to 6 in. in size to cover the same range as the plug gages. In addition to the gages just described, the Leonard line embraces the following gages and tools: Standard taper ring and plug gages, plain and universal V-blocks, toolmaker's knees, taper test gages, measuring irons, adjustable bevel-edge squares, hardened and ground steel parallels, box parallels, adjustable-limit snap gages, and glass surface plates in two sizes. The latter do not warp as do steel plates, it is claimed.

Viking Wrenches

The Viking Specialty Co., 25 Bartlett St., Worcester, Mass., has placed on the market a line of socket wrenches put up in sets of various combinations for



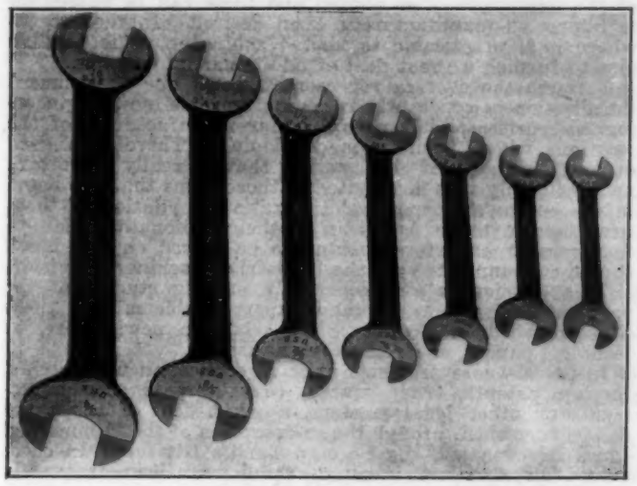
VIKING WRENCHES (GENERAL SERVICE SET)

automobile work. The general service set, illustrated herewith, comprises a double-end ratchet wrench, sixteen sockets for hex head screws and nuts, three extensions and a handle. The extensions and handle are fitted with ball frictions to hold the sockets from slipping off.

In addition to the set illustrated, the wrenches are put up in factory sets for shop assembling work and in owners' sets to fit the bolts and nuts on any particular make of car.

Mechanics Tool Co. Double End Wrenches

The accompanying illustration shows a set of double-end wrenches recently placed on the market by the Mechanics Tool Co., Rockford, Ill. These wrenches are drop-forged from tool steel and are oil tempered. The angle of the jaws makes it possible for the user to work in tight places and get a firm hold on the nut or screw head, and at the same time



MECHANICS TOOL CO. DOUBLE END WRENCHES

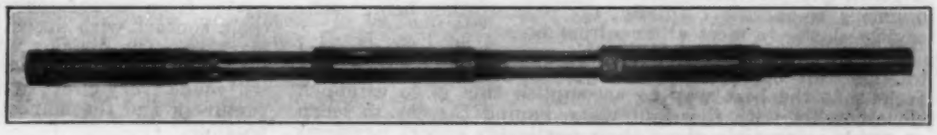
have full benefit of the leverage without danger of the wrench slipping and injuring his hand. The opening in the larger end of each wrench is of the correct size to fit a U. S. standard nut while the small end is made to fit an S. A. E. standard nut or bolt head. This feature is intended to make the wrenches useful for the automobile mechanic. The set covers fourteen sizes of openings without duplication. The wrenches are fully guaranteed by the manufacturer.

New Britain Line Reamer for Ford Crankshaft Bearings

The New Britain Tool and Manufacturing Co., New Britain, Conn., has added to its products the line reamer shown in the accompanying illustration, and which is especially constructed for the purpose of reaming the crankshaft bearings of Ford automobile engines.

The same principle of expansible diameters and pilot blades is applied to this reamer as to the regular line. The blades are ground to a true circle for a distance equal to about one-third of their length from the entering end. This diameter is so calculated as to follow the hole in the newly babbitted bearings, left by the babbitting fixture made by the same company.

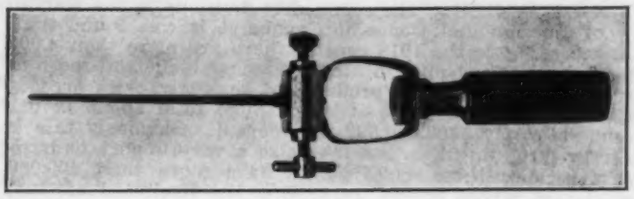
The range of expansion is from normal to about ⅛ in. oversize.



LINE REAMER FOR FORD CRANKSHAFT BEARINGS

Coats Hand Pin Vise

The hand pin vise shown in the accompanying illustration has recently been placed on the market by the Coats Machine Tool Co., Inc., 110 West 40th St., New



COATS HAND PIN VISE

York, N. Y. The upper part consists of a flat lyre-shaped spring, the ends of which hold the two movable jaws. The jaws and the ends of the spring are held together by a frame, in which the clamping screw and the knurled adjusting screw are fitted. These screws are provided with hardened pin ends, which project into the jaws, preventing the latter from sliding. The handle is hollow to admit pieces longer than the depth of the spring, and a washer and nut are used to hold the spring to the handle.

A piece, whether straight or tapered or of irregular section, is gripped along the entire length of the jaws when the clamping screw is tightened, due to the accommodating power of the springs. One of the jaws is slightly notched. The grip obtained on a taper, like that on the shank of a file or reamer, is very rigid. Long pieces extend through the hollow handle and are centered by means of the knurled adjusting screw. It will be noted that independent movement of each jaw in relation to the central axis is permitted.

Zahn Cycle Car

Word comes from H. W. Adams, representative of the Department of Commerce in Germany, that the Zahn Co. (Ltd.) has recently introduced a small two-seated, 4 to 9 horsepower cycle car. It is claimed to be cheap in price, cheap in upkeep, and simple in construction.

The car sells at retail in Germany for 40,000 paper marks (about $323, at exchange rate on Oct. 5, the date of report). It has a torpedo-shaped wooden body about 9 ft. long, with a maximum width of about 4 ft. The motor is of a two-cylinder air-cooled V-formed construction. The gas is regulated by foot pedal and hand lever. The car weighs about 300 kilograms, develops a speed of from 60 to 65 kilometers an hour, and consumes about 5 liters of gasoline and about one-half liter of oil per 100 kilometers.

The Industrial Machinery Division of the Department of Commerce

The Machinery Production and Trade of the United States—How the Department of Commerce Is Organized To Serve the Machinery Industry

By W. H. RASTALL
Chief, Industrial Machinery Division

IN ORGANIZING the commodity divisions in the Bureau of Foreign and Domestic Commerce it was found that, according to the 1919 census, there are more than 4,000 factories in the United States producing industrial machinery. The value of the products of these factories exceeds $2,200,000,000 per year, of which huge total about 17 per cent or nearly $400,000,000 is exported. Obviously this is a very large business, but it is also a very important business because these 4,000 plants have more than 400,000 employees whose income represents the livelihood of, say, 1,500,000 of our people, and the export business is of such volume as to represent the difference between profit and loss in the operation of many or most of these plants. It represents the difference between good times or depression, between a job and unemployment. The Industrial Machinery Division was developed in order to defend and promote this trade.

The figures given above are obtained by combining the returns of the census and the customs, and there are differences in the classifications which are apparent in the details as published in the accompanying table, but it is still felt that the general impression conveyed by these figures is substantially correct.

	Plants	Production	Exports	Per Cent
Air compressors	57	*57,454,000	3,761,200	6.5
Concrete mixers	62	9,579,000	246,631	2.6
Elevators and elevator mchy	195	54,052,000	2,601 543	4.8
Engines	371	464,770,000	48,370,483	19.4
Excavating machinery	34	6,641,000	1,165,763	17.5
Flour and grist mill machinery	86	16,366,000	2,375,802	14.5
Power laundry machinery	30	10,341 000	796,053	7.7
Machine tools	403	212,225,000	22,627,477	23.6
Metal working machinery (other than machine tools)	155	36,348,000	35,880,465	
Meters—gas and water	39	*20,572,000	763,691	3.7
Mining machinery—oil well	61	22,219,000	3,613,972	16.2
Mining machinery—other	124	43,028,000	9,265,319	21.5
Paper and pulp mill machinery	121	16,198,000	3,958,873	24.4
Printing presses	45	15,520,000	3,827,038	24.7
Pumps and pumping machinery	204	*65,360,000	9,067,458	13.9
Refrigerating machinery	84	29,901,000	2,141,110	7.1
Railway cars	121	403,517,000	60,748,946	15.0
Road-making machinery	43	13,915,000	987,912	7.1
Shoe machinery	58	7,459,000	2,839,828	38.0
Sugar mill machinery	49	13,249,000	13,805,940	
Textile machinery	431	126,006,000	14,986,369	11.9
Typesetting machines	92	24,531,000	3,932,544	16.0
Sawmill machinery	69	10,046,000	1,141,248	11.4
Other wood-working machinery	172	19,536,000	2,603,407	13.3
Others	1,198	570,738,000	138,202,092	24.2
Total	4,304	$2,269,571,000	$389,711,154	17.2

*Includes value of al, products of establishments engaged primarily in the manufacture of machines specified.

The Industrial Machinery Division has been instructed to give attention to industrial machinery, the kinds of equipment coming within this classification being suggested by the items given in the table which may be more generally described as including every kind of machinery used in any kind of a factory, power plant or mine; or that runs on a railway, or is used in the construction of engineering enterprises. Agricultural and farm machinery, including tractors, etc., is handled by the Implements and Vehicles Division; automobiles and aircraft by the Automotive Division; electrical equipment by the Electrical Division; plumbing supplies by the Specialties Division, etc. When a given problem seems to be on the border line the two divisions co-operate cordially, the organization being sufficiently elastic to meet all requirements.

The division aims to be of the greatest possible service to American manufacturers and exporters of machinery and feels that the best way to accomplish this is to establish close contact with these interests, hoping thereby to learn as much as possible about their particular export problems and the information manufacturers actually need regarding the various foreign markets. Having developed these problems it will be possible to secure help in their solution from the 600 representatives the Government maintains in foreign countries or, should circumstances justify, arrangement could be made to send special investigators into those fields and such tasks would be assigned to experts peculiarly qualified for the work. No problem is too large or too small for this service. Where practicable the division hopes to establish this contact with the manufacturers through committees appointed by their trade associations, or in some similar way.

Services the Division Offers

In the various markets of the world different sales methods are employed in marketing machinery, and the experts of the division are familiar with these methods. Where it is wisest to sell through agents or dealers, they have reasonably complete lists of all available candidates in each of the important cities abroad and these can be passed on to interested manufacturers when desired. In those cases where it is practicable to visit Washington, it is possible also to furnish a great deal of additional information.

Through the oversea representatives of our Government the division is constantly receiving word of new engineering enterprises and is notifying our manufacturers of the locations where business is developing. There is a good deal of this sort of information that is really important and ordinarily it is distributed to those firms that are listed in the bureau's "Exporters' Index," a compilation of those firms known to be American in their nationality. Manufacturers or exporters wishing to be placed on this index should communicate with the Industrial Machinery Division.

This division is also constantly making studies of the various foreign markets and export problems and these are published in *Commerce Reports*, the newspapers, or technical papers, as circumstances justify.

In cases where problems arise in connection with tariffs, foreign patents, trade marks, copyrights, agency agreements or other legal matters, a great deal of assistance can be furnished through the co-operation of the Commercial Laws Division and the Foreign Tariffs Division. In cases where disputes are involved, the bureau can frequently assist in the making of an adjustment.

The Industrial Machinery Division has just started to collect the laws and regulations of all foreign countries covering the inspection, construction and operation of steam boilers, air receivers and similar containers. In co-operation with the Electrical Division it plans to secure a similar collection of the electrical regulations of the whole world. These will be available for the use of American manufacturers and exporters of machinery, as circumstances show this is necessary. A general survey of the railway mileage and rolling stock of the world is in preparation, and an effort will be made to have this indicate extensions in prospect during 1922 and, if possible, 1923. In co-operation with the Automotive Division a similar survey of the highways of the various countries of the world is being made, including such returns as will indicate the prospective market for automobiles and trucks as needed by that division and the market for construction machinery as needed by the Industrial Machinery Division. A similar survey of the steam, water power and other electric stations of the world is being prepared in co-operation with the Electrical Division for similar purposes.

The Industrial Machinery Division is new and there is a great deal of important work to do, but in making plans for this work the division wishes to have the benefit of advice from manufacturers, in order to have the benefit of their contact with specific problems in the various foreign markets. The division will welcome advice and suggestions from interested manufacturers in preparing its plans and will make every effort to have the contact between the manufacturers and the markets abroad as direct and perfect as possible.

One such opportunity that will soon develop will be in connection with the Centennial Exposition to be held at Rio de Janeiro, Brazil, in September, 1922, which is to emphasize the possibilities of industrial development there, and in which a number of our manufacturers will undoubtedly wish to be represented.

NEWS SECTION

Tax Bill Only Temporary Measure

While the tax bill is admitted by its authors to be an imperfect measure, it does provide for a substantial reduction in the tax burden and greatly simplifies the administration of the law. The bill in its final form will require the payment of some $725,000,000 less during the first fiscal year that it is in full operation, than would have been raised had the law it supersedes remained in effect.

The repeal of the transportation and so-called nuisance taxes means a reduction of $326,630,266 during the fiscal year beginning July 1, 1921. That feature of the bill alone is held by many to justify its enactment. It was stated officially at the White House and by the chairman of the Finance Committee that the bill is intended as a temporary measure only.

In its final form the bill is expected to yield $3,216,100,000 in the fiscal year beginning July 1, 1922 and $2,611,100,000 in the fiscal year beginning July 1, 1923. For the fiscal year of 1922, the bill is expected to raise some $16,000,000 in excess of the government's requirements.

The Senate accepted the House rate of 12 and one-half per cent applicable to the corporation income tax. This reduction of two and one-half per cent from the rate proposed by the Senate will reduce by $110,000,000 the annual tax burden of business.

Bureau of Standards Wants Aids and Apprentices

The United States Civil Service Commission states that the Bureau of Standards at Washington, D. C., is in need of junior aids and laboratory apprentices.

The basic pay offered is $540 a year for apprentices and $720 to $840 a year for aids, to which salaries there is added the increase of $20 a month granted by Congress. Junior assistants at the Bureau of Standards are given opportunity to continue their college work at the universities in Washington, the courses of which are largely arranged to suit the convenience of persons in the government service.

Applicants are not required to undergo a written examination but are rated upon the subjects of general education and experience.

Full information and application blanks may be obtained by communicating with the United States Civil Service Commission, Washington, D. C.

Business Paper Editors Confer With Secretary Hoover

The regular monthly dinner conference of the editors of the business papers of the country with Secretary of Commerce Herbert Hoover, was held at the New Willard Hotel in Washington on Nov. 28. The main topics of discussion were the two departmental publications issued by the Bureau of Foreign and Domestic Commerce, *Commerce Reports* and the *Survey of Current Business*. Mr. Hoover had asked at the previous conference for careful study of these two periodicals and constructive criticism. A committee of the editorial conference to which the matter had been entrusted, reported the consensus of opinion and offered several suggestions which will be adopted.

Franklin Institute Awards Longstreth Medals

Acting through its Committee on Science and the Arts the Franklin Institute, of Philadelphia, has awarded the Edward Longstreth medal to Governor James Hartness, of Vermont, and to Thomas W. Hicks, of Minneapolis.

Governor Hartness won the honor through his invention of the screw thread comparator, which ranks high in the mechanical perfections of the present day.

Mr. Hicks' award is based on his invention of the "once-over" tiller, a machine that thoroughly pulverizes the ground ready for sowing of the seed. No further use of disks or harrows is necessary after the Hicks machine has done its work.

Dr. Walton Clark, president of the Institute, made the presentation address.

Manufacturers to Debate American Valuation

According to a Chicago correspondent, one of the big features of the annual conference of the Illinois Manufacturers' Association, to be held Dec. 13, at the Congress Hotel, will be a debate on the subject of American valuation as proposed in the Fordney tariff bill. George R. Meyercord, president of the Meyercord Co., formerly a director of the American Manufacturers' Export Association, will speak affirmatively, while William H. Mann, general manager of Marshall Field & Co., wholesale, will give the view expressed by importers and retailers.

Wetmore Reamer Co. Enters Combine

Two Milwaukee tool manufacturing companies—the Wetmore Reamer Company, making a line of expanding reamers including cylinder reaming sets, and the Wisconsin Tool and Supply Co., manufacturer of special tools, jigs, dies, fixtures and thread gages—have been consolidated and will hereafter be operated under the name of the Wetmore Reamer Company.

The new organization will specialize in the manufacturing of expanding reamers for high speed and quantity production work; also expanding machine reamers under 1 in. which have been developed within the last six weeks. The building of tools, dies, fixtures and special thread gages will be continued as the entire equipment of machinery is precision made.

The officers of the consolidate corporation elected at a recent reorganization meeting are as follows: President and general manager, Edward J. Waltzer; vice-president, Charles G. Forster; secretary, Charles F. Puls, Jr.; treasurer, Carl A. Forster; general superintendent, Edward D. Johnson.

Senator Kenyon's Bill to Stabilize Employment

To carry out the policy recommended by the President's Conference on Unemployment and to prepare in advance against future cyclical periods of business depression and unemployment, Senator William S. Kenyon, of Iowa, introduced a bill in the Senate, providing for the long-range planning of public works. This bill was referred to the Committee on Labor of the Senate.

The preamble of the bill states: "Whereas a sound economic policy requires that a larger percentage of the public works and projects of the United States be undertaken and prosecuted during a period of major industrial depression and unemployment, when labor and capital are not fully employed in private industry, that a smaller percentage of such works and projects should be undertaken and prosecuted during a period when private industry is active and competing for the same men and material with resulting business strain and overextension, and that the prosecution of such works and projects should be utilized as a stabilizing force during a period of over-expansion as well as during a period of depression."

It is reported the bill is favorable to both houses.

A.S.M.E. Confers Honorary Membership on Towne and Herreshoff

At the Tuesday evening session of the annual meeting of the American Society of Mechanical Engineers, now being held in New York City (Dec. 5 to 9) two honorary memberships were conferred.

Henry R. Towne, president of the Yale & Towne Manufacturing Co., and Nathanael G. Herreshoff, marine engineer and boat designer, were the recipients of this high honor.

Henry R. Towne has been a member of the A. S. M. E. since 1882, serving as vice-president from 1884 to 1886, and as president in 1889. He is a life member of the society. Mr. Towne graduated from the University of Pennsylvania in 1862. In his early career, associated with Robert Briggs, he made a series of experiments with leather belting, the results of which were accepted as standard for twenty years. In 1868 he formed a partnership with Linus Yale, which later assumed

HENRY R. TOWNE

the organization known as the Yale & Town Manufacturing Co. Mr. Towne has directed this company as president since 1869.

During thirty-six years of development he produced almost every improvement in locks or lock-making machinery. He also has contributed much to the development of Post Office equipment, chain hoists and all manner of art hardware.

Mr. Towne's unusual combination of business and mechanical ability and his untiring efforts to create and maintain a product of service and excellence, have made him a recognized factor in the growth and prosperity of the lock industry.

Nathanael G. Herreshoff graduated as a mechanical engineer from the Massachusetts Institute of Technology, in 1869. He had a natural inclination toward mathematics and possessed unusual ability as an engineer.

One of his first noteworthy accomplishments was the design and construction of a rotary engine which embodied many novel and ingenious features. In 1876 he erected the great Corliss engine which was exhibited at the World's Fair in Philadelphia. A few years later he designed some compound engines which were copied by many engineers. These engines were subjected to elaborate tests by B. F. Isherwood, then chief engineer of the U. S. Navy.

Mr. Herreshoff is credited with making the first torpedo boat designed for the Government and during the Spanish-American War built the "Porter" and the "Dupont," which far exceed

NATHANAEL G. HERRESHOFF

their contract requirements. His work as a naval architect is known the world over. His design of hulls and ship rigging has been copied by all countries. It was he who designed the yachts which defended the America's Cup on numerous occasions. His contributions to the field of marine engineering have been greatly underestimated because of his failure to patent his designs.

American Trade in Argentine

The foothold which American business has gained in the Argentine is threatened by the apathy of American bankers and manufacturers, declares M. T. Meadows, manager of the Chamber of Commerce of the United States in the Argentine Republic. In a statement appealing to those interests in America which are yielding to unwarranted pessimism, he begs that they inform themselves correctly regarding what the chamber believes to be an unexcelled opportunity to build up a growing and tremendous trade with the South American republic.

The spirit of pessimism concerning the future of Argentine trade which has settled like a pall upon American bankers, manufacturers and exporters, is viewed with alarm by the American business community in Buenos Aires.

"Courage in the face of odds is as essential to success in the Argentine business as it is in trade within the borders of the United States. Argentina has just passed through one of the most critical commercial crises in her history. Naturally those interested in trading with this country have felt pessimistic in the immediate past.

The internal conditions of the country are fundamentally sound. This statement has been repeated so often to the American public that it has now become trite. And yet it is only by dint of constant repetition that facts concerning Argentina are driven home to American bankers, manufacturers and merchants. It is also well to repeat that Argentina, with the fifth largest gold supply in the world, has the highest gold guarantee for paper circulation of any nation. This guarantee today stands at slightly over 80 per cent.

Indications of Business Improvement

Bits of news coming from various industrial centers indicate a gradual improvement in the complexion of the machinery industry.

The Chicago & Alton Railroad has awarded a contract for the repair work of 150 gondola cars to the Street Co., of Chicago.

The Burlington has awarded a contract to the General American Tank Car Co., of Chicago.

The operations of leading steel mills in the Chicago district continue at a new high capacity started about 10 days ago.

The Illinois Steel Co. and the Inland Steel Co. are operating close to 50 per cent of their capacity.

Two new automobile companies, Durant Motors, Inc., and the Rickenbacker Automobile Corporation, both of Detroit, have made purchases. Durant Motors, Inc., bought 30 turret lathes and other new and slightly used tools, while the Rickenbacker Corporation acquired several miscellaneous tools.

Railroad buying has been confined to small lots. The Virginia Railroad, which took 10 tools, was the largest purchaser. The Union Railroad, Pittsburgh, a subsidiary of the United States Steel Corporation, has bought a radial drill, lathe and planer. The New York Central has purchased two lathes from Government stocks at Hog Island, Philadelphia. The Santa Fe, Rock Island and the Illinois Central have also bought in a small way.

As a result of a general betterment in the automobile situation, which has brought increased shipping specifications for Jan. 1, the Electric Auto-Lite Corporation will increase its force to 2,100 employees after the turn of the year, C. O. Miniger, president of the company, announced Tuesday. Approximately 1,400 workers are now employed at the Auto-Lite.

The Toledo Bridge and Crane Co.'s plant in Toledo, Ohio, will go on full time soon, as the result of a several million dollar contract with the Brazilian government just closed by the Austin Machinery Corporation, of which the Toledo company is a subsidiary.

Rolls-Royce of America, Inc., Springfield, Mass., has resumed the operation of its machine shop and is now employing about 100 men in the various departments, producing at the rate of two chassis a week. It is planned to bring production to the normal rate of four to five chassis a week.

The Chapman Valve Manufacturing Co., Springfield, Mass., began operating on full time and with a practically full force beginning Nov. 28.

An official announcement on Nov. 28 from the master mechanics' office of the L. & N. R.R., at Evansville, Ind., states that practically all of the 200 men who have been out of service in the Howell shops since the first of the year, have been replaced in their various departments. This announcement seems to be indicative of a return to normal in all departments of the road. The men were notified to return to work and 25 boilermakers and machinists reported Monday morning. This leaves but a few yet to be replaced. The majority of these are machinists and it is expected that they will be reemployed within the next week or ten days.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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In almost every direction the effect of cheaper money and more abundant credit is becoming apparent. Even before the Disarmament Congress met in Washington the bond market had commenced to reflect the lower rates at which capital could be borrowed, but within the last week the demand for well secured obligations has been almost insatiate and an issue of $30,000,000 bonds offered by the New York Edison Co. on a basis that yields 6.10 per cent, is said to have been thirty times oversubscribed. The advance in Liberty Bonds has meantime continued. Victory Bonds paying 4¾ per cent have sold at par and the entire list of government war bonds shows an average advance of about 10 per cent from the low prices of the year. Experts claim that at current market quotations the American bond issues now outstanding are worth at least $5,000,000,000 more than they were six months ago.

But striking as it is the appreciation in bond values is not as important as the better feeling and upward tendency that is manifest in many commodity markets. The advance in petroleum is well maintained. Wheat is again higher. Corn is firmer. Copper is up to 13¾ cents. Silk has recently advanced about $1 per pound. Crude rubber is firm and higher. So is coffee, and while cotton is seemingly static it resists the attacks of those who think that the higher crop estimates now generally accepted justify a decline. In the case of these articles the improved demand or the lessened eagerness to sell will probably be attributed to special trade factors by those who deal in them, but in the larger view a general return of confidence is reflected by the stronger tone that is apparent in so many different markets.

Pervading them all is the consciousness of a change in psychological conditions which is due to the belief that when the capital, without which labor is almost impotent, can be hired at rates that are not exorbitant people will produce more, earn more and spend more, with the result that there will be more business for everyone.

This is almost an economic truism. I have urged its recognition ever since our bank reserves commenced to rise, but the public was slow to accept it and the conjunction of the Disarmament Congress with a reduction in interest rates was necessary to dissipate the clouds of pessimism that obscured the sunshine of normal hopefulness.

Gold Reserve Rises

The Federal Reserve statement for the week shows a further rise in the reserve ratio, which now stands at 72.7 per cent, and a gain of $14,000,000 in the gold held. These figures have led some to predict another reduction in the rediscount rate, but whether it is ordered or not they assure easy money for some time to come, and in that assurance men are willing to undertake new enterprises and adventures. Building is abnormally active for this season of the year. The steel industry is getting busier because the railroads and the oil companies are buying. The shoe factories and the textile mills are running nearly on full time and there is nowhere to be discerned the distressful unemployment that was generally predicted eight weeks ago.

Railroad net earnings for October will probably exceed $92,000,000 and the position of the roads is so much improved that the attempt to enact the refunding bill will be abandoned. It seems to be difficult nevertheless to get freight rates down, for the Interstate Commerce Commission has refused to sanction the proposed reduction of 10 per cent in the rates on agricultural products though it holds out the hope of a generally lower tariff later on. The Labor Board is concurrently deliberating upon another revision in wages, but the public is confused over the questions at issue and impatient at the delay in reducing the cost of transportation. Now that the hope of reduced taxation has been balked, people are wondering whether they are also to be denied the promised reduction in freight and passenger rates. It is the thing most needed to quicken the recovery in domestic trade.

Exchange Better

In Europe, as in this country, a constructive policy seems at last to be in the ascendant. It is proposed to give Germany two years respite, euphemistically called a moratorium, in the payment of her reparations and the result has been a sharp advance in foreign exchange. Sterling has sold at 4.07¼, francs are sharply higher and even the discredited mark is up to 56 cents a hundred despite the Reichbank's statement which shows that 96 billion paper marks were outstanding on Nov. 23, against which there was held only 993 million marks in gold. Unless the German chemists shall find a way to make synthetic gold it seems futile to expect that even at their present discount these paper marks will much longer be exchangeable for things of real value.

In Russia a new ruble is to be issued which will have a flat value that will make it worth 10,000 of the rubles now outstanding. By this plan Russia's millions of millionaires will be painlessly reduced to a lower financial status. It may be that something of the sort will be attempted in Germany, but unless one knows what will be the ratio between the old money and the new he cannot hope to profit by the change, and those who buy marks are playing with cards that will be stacked against them. The recent advance in exchange is, however, a fact that is of advantage to America, as it facilitates exports and for that reason it is to be counted as encouraging.

But from the optimism of the foregoing it is not to be inferred that the horizon is entirely cloudless. Overseas the unsolved Irish problem still taxes the seemingly inexhaustible patience of Lloyd George. In its involvements it has become almost incomprehensible to Americans.

In Portugal the spread of Bolshevism has so alarmed the neighboring governments that it is proposed that Spain, Italy and France shall jointly occupy and administer the country under a mandate from the League of Nations. In India there is still much unrest although news of it has been stifled while the Prince of Wales is there, and in Washington a discordant note is occasionally to be heard at the Disarmament Congress.

In so far as our domestic situation is concerned the one weak point is the farmer's predicament. In 1910 there were 12,659,082 persons or 33.2 per cent of the nation's workers, who were engaged in agriculture, forestry and animal industry. By Jan. 1, 1920, the number so employed had fallen to 10,951,074 or 26.3 per cent, and a report just issued by the census bureau shows that during the year 1920 no less than 7 per cent of those employed in rural pursuits had moved cityward.

There are some who are complaining that there is an agricultural "bloc" in Congress which concerns itself chiefly in protecting farmers.

But is this surprising? As I write I have before me a resolution passed by the board of supervisors of Pocahontas County, Iowa, in which the purchase of corn for "fuel to heat the Court House, County Home and Insane Asylum" is ordered because "the price of corn is less than one-third of a cent a pound while coal costs more than two-thirds of a cent a pound." This resolution states in succinct form a problem to which our economists and statesmen may well address themselves. If a solution for it can be promptly found we shall enjoy great and sustained prosperity.

Tests on Ball Bearings

At the suggestion of the Navy Department, the Bureau of Standards undertook to determine the maximum safe load and the static friction under load of ball and flexible roller bearings. Tests were made on balls and rollers of different sizes and with races having different radii. The hardness of the balls, rollers and races also varied.

The results of this work are described in Technologic Paper No. 201 of the Bureau of Standards, obtainable from the Superintendent of Documents, Washington, D. C., at 10 cents per copy. The methods of conducting the tests are described, and conclusions given which will be of value to any one interested in the design of ball and roller bearings.

Decision of Railroad Labor Board Establishes "Open Shop"

The decision handed down by the United States Railroad Labor Board, and which became effective Dec. 1, created considerable comment throughout the country. One of the most important things which the decision does is put the railroad shops on an "open shop" basis, by recognizing the right of minorities to present their grievances and request remedies or changes in certain conditions. At the same time the board recognizes the unions by upholding the right of collective bargaining.

Recognizing the "open shop" principle as applied to the railroads will mean an annual payroll saving to them of about $50,000,000. It will form the ground work on which the adjudication of all future wage disputes between the roads and their employees will be based. The new rules became effective Dec. 1, and will effect approximately 400,000 employees immediately. When normal conditions are restored more than 450,000 men will be affected.

Unions Affected

Eight unions are affected by the decision, all affiliated with the railway employees' department of the American Federation of Labor. They are the Brotherhood of Railway Carmen, International Brotherhood of Blacksmiths, Drop Forgers and Helpers, International Alliance of Amalgamated Sheet Metal Workers, International Association of Machinists, International Brotherhood of Boilermakers, Iron Ship Builders and Helpers and the International Brotherhood of Electrical Workers.

Ben W. Hooper, vice-chairman of the board, announced that this decision will leave that body free to take up the consideration of further wage reductions or increases as soon as applications are made.

During the recent strike crisis the six shop crafts affiliated with the American Federation of Labor—the carmen, sheet metal workers, machinists, boilermakers, blacksmiths and electrical workers—voted not to walk out with the brotherhood but to await the Labor Board's decision on the working rules. Although the decision is considered highly favorable to the railroads and relieves them of most of the rules of which they complained under the national agreement, there is one fact that augurs for its acceptance by the unions.

No Dissension in Board

This is that the present decision is unanimous and is not accompanied by a dissenting opinion from the labor group on the board as was the former one revising twenty-four of the shopcraft rules. That one, handed down six months ago, also lopped $50,000,000 from the roads annual payrolls, according to the board's computation, and was opposed by A. O. Wharton, a member of the labor group. Representation of minorities in grievance cases is provided for, thus doing away with that part of the national agreement, criticized as forcing the "closed shop."

The principle of the "open shop" established by the new rules will, in fact, be more theoretical than practical at the present time, since a large majority of the railroad shops are unionized and the existing unions are recognized by the board and by the Transportation Act as representatives of the majority.

Most of the older working rules, sanctioned by the experience of years, are preserved in full effect. Many of the more rigid rules, however, are considerably relaxed in favor of the roads, although recognized rights of the men are fully protected and the principle of collective bargaining and union recognition is retained as contemplated by the Transportation Act.

Mechanical Engineering Leads

Of the 9,084 resident students enrolled in the University of Illinois this term, 1,892 undergraduates have registered in architecture and engineering in the college of engineering. Mechanical engineering leads with an enrollment of 418. The courses offered and the number of students in each, are as follows:

Architecture	112
Architectural engineering	129
Ceramic engineering	72
Chemical engineering	218
Civil engineering	336
Electrical engineering	415
General engineering	43
General engineering physics	2
Mechanical engineering	418
Mining engineering	86
Municipal and sanitary engineering	10
Railway engineering	51
Total	1,892

J. L. Blair, of Niles Tool Co., Dead

Joseph L. Blair, secretary and assistant treasurer of the Niles Tool Works Co., of Hamilton, Ohio., died at his home in that city on Nov. 18. He was 60 years old.

Mr. Blair entered the employ of the Niles company in 1878 and advanced

JOSEPH L. BLAIR

rapidly through various positions to that which he held at the time of his death. He was at one time office manager of the Gordon & Maxwell Co., a subsidiary of the Niles company. In 1890 he was appointed purchasing agent for the Niles company. In 1888 he was elected secretary and in 1912 acquired the additional office of assistant treasurer.

Mr. Blair was greatly interested in welfare work in Hamilton, being a director in the Y. M. C. A. and a supporter of church and community activities.

His many friends in the machine tool industry have lost a true and brilliant friend and co-worker.

R. A. Feiss Elected to Presidency of the Taylor Society

Richard A. Feiss, of Joseph & Feiss Co., Cleveland, Ohio, was elected president of the Taylor Society at its annual meeting, held in New York City on Dec. 1, 2 and 3. Other officers elected were Robert B. Wolf and H. K. Hathaway, vice-presidents; E. W. Clark, treasurer, and H. S. Persons, managing director.

The board of directors for 1922 comprises Ida M. Tarbell, of New York; L. Herbert Ballou, of Boston; R. M. Hudson, of Peoria, Ill., and J. C. Heckmann, of New York.

The conference opened on Thursday with the regular business meeting, at which reports of committees and election of officers took place. In the evening the society heard a very interesting discussion on the technique of the appraisal of the efficiency of an industry. L. W. Wallace, executive secretary of the F. A. E. S., presided.

The meeting resolved itself into a spirited discussion of the valuation sheet devised and used by the engineers of the Committee on Elimination of Waste in Industry. C. E. Knoppel, of New York, explained the use of the sheet and the audience was asked to criticize or offer suggestions for improving the method.

On Friday morning W. E. Freeland, of the Winchester Arms Co., led a discussion on sales engineering. He presented a report, based on the answers to a questionnaire sent out by the society, and gave some excellent suggestions on sales research, sales promotion and merchandise control.

At the same session Charles F. O'Connor, of the Universal Winding Co., read a paper on production management. He discussed the abnormal conditions of the market, brought on by the war, and the change from a sellers' to a buyers' market.

The Friday afternoon session was devoted to a discussion of sales cost accounting by Charles P. Staubach, of the Burroughs Adding Machine Co. In the evening W. H. Leffingwell presented a paper on the principles of scientific management in the office.

Other papers read at the remaining sessions were: "General Control of Business," by John H. Williams; "Combination Routing," by D. J. Walsh, Jr.; "Formula for an Efficient Workman," by Boyd Fisher.

The meeting ended Saturday noon with a luncheon in honor of Henry R. Towne, honorary president of the society. Mr. Feiss, newly elected president, presided.

Auto Body Builders To Exhibit

The Twelfth Regiment Armory, New York City, has been selected for the first automobile body show, to be held on Jan. 9 to 14, 1922, under the auspices of the Automobile Body Builders Association.

The exhibits will be confined to commercial and passenger car bodies and to the materials and parts that are used in fabricating them. Bodies of every type will be shown. Some will be finished and trimmed, others will be in the "white" making possible an examination of framing, metaling and other constructive features.

The show is under the management of the Body Builders Exposition Co., Inc., 1819 Broadway, New York City.

Business Items

The Exeter Machine Works, Inc., of West Pittston, Pa., announces the appointment of the W. P. M cKenzie Co. as exclusive sales agent for the Exeter rotary pump line in the Philadelphia and Baltimore districts. The MacKenzie company specializes in the marketing of pumping machinery, with offices in the Pennsylvania Bldg. in Philadelphia and in the Equitable Bldg. in Baltimore.

The Hicks-Crawford safety device for air hammers and drills was recently demonstrated at the Terre Haute boiler works, at Terre Haute, Ind., before a gathering of men interested in mechanics and in safety appliances. Encouraged by the approval of such men as Dr. Phillip Woodworth, president of Rose Polytechnic, E. T. Hazeldine, machine shop owner, and Harry Cliff, of the Terre Haute Boiler Works, the firm of Griffith, Hughes & Merrifield has organized a company of Terre Haute people for the manufacture and distribution of the device. The idea was perfected and the model made by D. M. Crawford, of the Crawford-McCrimmon Machine Co., of Brazil, Ind., and he is a partner in the patent rights on the appliance.

Loy & Nawrath Co., of Newark, N. J., manufacturer of presses and sheet-metal machinery, has opened offices at 30 Church St., New York City.

The J-B Engineering Sales Co., of Hartford, Conn., has moved into larger quarters at 54 Church St., in that city. Increase in the company's business made this change necessary. The company specializes in power-plant equipment and is a distributer for Sells roller bearings, Royersford products, Terry steam turbines, the Griscom-Russell Co., and the Conveyer Corporation of America.

The Welborn Corporation, of Kansas City, Mo., has acquired the patents, plant and equipment of the Coleman Tractor Co. The Welborn organization was recently incorporated with a capital stock of $4,000,000. Officers are: F. I. Welborn, president; A. Coleman, secretary; L. N. Burns, counselor.

The Pittsburgh Machinery Co., Pittsburgh, Pa., has been taken over by the Bradley Company. The old business will be continued along the same lines at 301 Jones Law Building.

A series of tests of semi-automatic rifles for Army use was begun Nov. 28 at the United States Armory in Springfield, Mass. Rifles were first submitted by the Colt Manufacturing Co. and the United States Machine Co. A testing board of the War Department, of which Gen. Samuel Hof is senior member, conducted the tests. Others present were Gen. Fred H. Phillips, secretary of the National Rifle Association; Col. Charles E. Stodter, director of civilian markmanship, Gen. William S. Pierce and Col. E. D. Bricker of the Ordnance Department.

It was recently announced by W. H. Sullivan, mayor of Bogalusa, La., that the Southern Lumber Co., will erect a new million-dollar paper making plant in Bogalusa. The plant will be equipped with the latest and most efficient machinery, and will be a duplicate of the present Bogalusa Paper Company's plant.

Through a complaint filed by the Warner & Warner Co., the Jersey City court has appointed E. B. Twardus, of Newark, as receiver for the Modern Tool and Machine Works, Inc., Newark.

The Milwaukee Tool and Forge Co. has moved to South Milwaukee, Wis. An increase of $50,000 in the capital stock of the company has been authorized.

The Karge-Baker Corporation, manufacturer of the Karge flexible couplings and transmissions, has moved its plant and main office from Phoenix, N. Y., to 658 Ellicot St., Buffalo, N. Y.

Personals

R. E. CHAMBERLAIN has been promoted to the position of general sales manager of the Packard Motor Car Co.

ARTHUR L. STONE, formerly sales manager of the Buffalo, N. Y., district for the Toledo Scales Co., has been transferred to the Atlanta branch as Southern district manager.

JOSIAH T. ROSE, vice-president of the J. B. McCrary Co., industrial engineers of Atlanta, Ga., and formerly vice-president of the Atlantic Steel Co., of Atlanta, has been named collector of internal revenue for Georgia under the Harding administration.

D. J. ASKEW has purchased a site in Dothan, Ala., for the construction of a warehouse and machine shop.

C. W. WRENSHALL, recently named general manager of the Pressed Steel Car Co., at Pittsburg, was formerly prominently identified with the iron and steel industries in the South, being manager of the Elliot Car Works, at Anniston, Ala., a plant formerly operated by the Pittsburg company.

OTTO AGRICOLA, head of the Gadsden, Ala., pipe manufacturing plant which bears his name, has been elected to the presidency of the Gadsden Chamber of Commerce.

H. P. HOFFSTAT, president of the Koppel Industrial Car Co., of Pittsburgh, Pa., has been elected vice-president of the Pressed Steel Car Co. He will retain his connection with the Koppel Company.

C. W. WRENSHALL has been appointed general manager of the Pressed Steel Car Co., of Pittsburgh, Pa.

CHARLES M. SULLIVAN has joined the sales force of Manning, Maxwell & Moore, Inc., of New York, in charge of the Shaw crane department. He was formerly sales manager in the Pittsburgh district, for the Milwaukee Electric Crane and Manufacturing Co.

B. B. EVANS has been appointed sales manager in charge of the Pittsburgh district of the Milwaukee Electric Crane and Manufacturing Co.

F. E. COOPER, of the Clark Equipment Co., gave an illustrated lecture on the manufacture of drills before the Purchasing Agents Association, of Pittsburgh, on Nov. 15.

H. M. BUSH, of Columbus, Ohio, has been appointed sales representattive in central Ohio for the Diamant Tool and Manufacturing Co., Inc., manufacturer of standard punch and die sets. RUSSELL PROPES, of Norristown, Pa., has been commissioned in a similar capacity in the southeastern Pennsylvania district.

WILLIAM M. MOODY, formerly connected with Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa., is now with Chas. C. Moore & Co., San Francisco, Cal. This is the Pacific Coast branch of the Babcock & Wilcox Co., manufacturer of water-tube steam boilers.

HARRY W. GIFFIN has opened a consulting and general engineering office in Springfield, Mass.

WILLIAM N. MCMUNN, previously with the Whitman & Barnes Manufacturing Co., Chicago., Ill., is now with the the Parish & Bingham Corporation, Cleveland, Ohio.

CHARLES A. STODDARD has been appointed superintendent of the Moore Shipbuilding Company at Oakland, Cal.

STANLEY P. ROCKWELL, formerly vice-president of the Weekes-Hoffman Company, Syracuse, N. Y., and more recently metallurgist for the Whitney Manufacturing Co., Hartford, Conn., has opened offices in Hartford for the practice of consulting metallurgical engineering.

CHARLES ADAMS, formerly a sales engineer with the Standard Roller Bearing Co., of Philadelphia, Pa., is now identified with the Bearings Company of America as sales engineer in the Eastern territory.

C. A. PECKHAM, president of the Toledo Bridge and Crane Co., Toledo, Ohio, has been elected a director of Canadian Austin Machinery, Ltd., Woodstock, Ont., Canada, a new organization of which B. A. Linderman, president of the Linderman Steel and Machine Co., Muskegon, Mich., and John Ross Shaw, vice-president of the Canadian Linderman Co., Ltd., are president and vice-president respectively.

Obituary

JOHN J. EDSON, JR., president of the Pittsburgh Water Heater Co., died at his home in Pittsburgh on Nov. 15. He was a son of John J. Edson, president of the U. S. Chamber of Commerce.

WALTER H. WESSON, former president of Smith & Wesson, firearms manufacturers, died at his home in Springfield, Mass., on Nov. 29. He was 71 years old. He was born at Grafton, Mass., a son of Daniel P. Wesson, founder of the firm of Smith & Wesson. He entered the factory of his father's company in a minor capacity, later being advanced to the office of secretary. He also served as vice-president and treasurer of the company before being elected president.

HENRY S. HALE for the last thtirty years connected with the Hale & Kilburn Manufacturing Co., died on Nov. 26 at Dixville-Notch, New Hampshire. Mr. Hale has long been identified with the manufacture of pressed steel products in the automobile trade.

JAMES MCCANN, SR., who for sixty years has been active in the management of the Henry Disston & Sons Co., manufacturer of saws, died at Glenolden, Pa., on Nov. 26.

Book Reviews

Waste in Industry. By the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies; 409 pages, 6 x 9 in.; illustrated by tables and charts. Published by Federated American Engineering Societies, Washington, D. C. McGraw-Hill Book Co., Inc., 370 7th Ave., New York, sole selling agents. Price $4.

The preliminary report of the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies was received by engineers with considerable criticism, which was undoubtedly justified to a certain extent, but which was partly due to the haste made necessary by the working schedule laid down for the industrial survey undertaken. The final report which has just appeared contains tabular matter some of which has little interest, but which includes material that should be vitally interesting to all those engaged in industry and to the public as well. It has been said that the conclusions reached could have been set down beforehand by any good economist. This may be true, but does it detract from the value of the dictates of common sense to have them corroborated by the figures obtained by an engineering survey?

Chapter I tells of the organization of the survey work and of the difficulties encountered. It also includes the remarkable calendar of the progress of the work which was instituted in January, 1921, and completed in July, when the final report was approved by the committee.

The second chapter is devoted to a summary of the various sources and causes of waste in the different industries studied, and the third to the general recommendations for their elimination. Even if little new material is offered here, it is worth while to have it in the form presented.

The following chapter gives the complete questionnaire used by the field investigators. This particular section is worth the price of the whole book to any manager who will take the questions and apply them to his own plant. He cannot fail to discover sources of waste that will repay in actual cash savings many times over. The average waste in the fifteen metal trades plants studied was 28 per cent, and the individual figures ranged from 6 to 56 per cent. It is a matter for congratulation that the average of efficiency for plants in the metal trades was apparently rather higher than those of the other industries studied, but there is still room for vast improvement.

Chapters V to X constitute Part II, which is headed "Engineers' Field Reports." The six industries included are the building industry, men's clothing manufacture, shoe manufacturing, printing, metal trades and textile manufacturing. The metal trades' report is naturally the only one of special interest to readers of the *American Machinist*, but the others are worth reading for general information.

As stated above, fifteen plants were studied in the metal trades group under the direction of Fred J. Miller, past president of the A. S. M. E., and former editor of the *American Machinist*. Among other things this report emphasizes the wastes involved in labor turnover, lack of standardization, lack of adequate cost control and cost systems and the shortcomings of management and labor.

Seven general reports are gathered together under Part III. They are not engineering reports nor are they new, but they serve to add digests of certain broad aspects of waste in industry to round out the whole report. The subjects covered are unemployment, strikes and lockouts, legal machinery for adjusting disputes, industrial accidents, health of industrial workers, eye conservation and purchasing and sales policies.

Annual Report of the Smithsonian Institute. Washington, D. C., 1919. Five hundred forty-six 6 x 9-in. pages, cloth board covers, illustrated.

This book describes the activities and condition of the institute for the year ending June 30, 1919. Its contents include chapters on the establishments of the institute, researches and explorations, National Museum, International catalog of scientific literature, and many scientific papers. There is also an appendix containing eight reports, on such subjects as the "Bureau of American Ethnology," "National Zoological Park," etc.

Trade Catalogs

Thread Cutting Tools: Williams Tool Corporation, Erie, Pa. A 5 x 7-in. catalog, 60 pages, presenting an interesting subject in a most unusual way. It is a story, or rather a comparison, of a business and a pleasure venture, carrying through its pages, a very strong moral. Each phase of the story describing the successive incidents in the venture, are very correctly illustrated; each ends with a moral. The rest of the brochure is devoted to subjects relative to pipe threading, tooling, oiling, proper selection of dies and some descriptions of Williams patented machines.

Grinnell Oil Piping. Grinnell Company, Providence, R. I. October issue of the "Grinnell Bulletin," devoted to a description of the work of converting 20,000 tons of pipe and fittings into six distinct piping systems 69 miles long.

"Northern" Cranes. Northern Engineering Works, Detroit, Mich. Bulletin No. 517 illustrating the use of electric traveling "Northern" cranes in foundry service.

Baker Boring and Drilling Machine. Baker Brothers, Toledo, Ohio. Catalog describing and illustrating the No. 121 light heavy-duty boring and drilling machine, the latest product of the company. Photographs of parts and details are included as well as easily readable specifications.

Radial Wall Drills. Pawling & Harnischfeger Co., Milwaukee, Wis. Bulletin No. 206, describing and illustrating the latest perfection of P & H wall drill, the No. 6. It is particularly adapted for interior or exterior drilling of steel drums and drilling and reaming of structural material.

Dry Vacuum Pumps. Chicago Pneumatic Tool Co., Chicago, Ill. Bulletin No. 710, giving a detailed description, with illustrations, of pneumatic dry vacuum pumps. Several types are shown including steam, belt and motor driven.

Cylinder Refinishing Machines. Bridgeport Cutter Works, Inc., Bridgeport, Conn. An eight-page circular describing a newly designed machine for finishing automobile cylinders by the use of a herringbone reamer instead of the usual grinding operation.

Cylinder Planers. Morton Manufacturing Co., Muskegon Heights, Mich. Bulletin No. 7, describing the latest model traveling head, draw-cut cylinder planer, built in 40- and 60-in. stroke, for railroad work. Specifications and lists of standard equipment are included; illustrations show planers performing various operations on railroad equipment. Another bulletin, No. 8, describes the draw-cut, traveling head planers arranged for boring and milling. These are built in 48-, 60-, 72- and 84-in. stroke, any length of bed.

Pillar Shapers. Smith & Mills Co., Cincinnati, Ohio. Catalog No. 2, describing a line of plain or single geared crank shapers, pulley or motor driven shapers, automatic attachments, tables, feed attachments and vises.

Brown Pyrometer. Brown Instrument Co., Philadelphia, Pa., a four-page circular announcing two improvements in the Brown high-resistance pyrometer—an automatic cold junction compensation and means of zero adjustment.

Graham Grinders. Graham Manufacturing Co., Providence, R. I. Circular B describing the new Graham grinder for rapid and accurate production of flat surfaces.

Excavating Equipment. Pawling & Harnischfeger Co., Milwaukee, Wis. Bulletin No. 56 X, describing a comprehensive line of excavating tools including cranes, scoops, buckets, dredges, pile drives, shovels and many other machines.

Time Studies. Smalley General Co., Inc., Bay City, Mich. Series "C" giving the results of a time study on a Smalley General thread miller, No. 23, cutting a machine steel gage.

Precision Ball Bearings. The Norma Company of America, Long Island City, N. Y. A small circular covering a line of ball, roller, thrust and combination bearings.

"National" Hammer-weld pipe. National Tube Co., Pittsburgh, Pa. Bulletin No. 13, describing a new product which this company has added to its line—hammer-weld pipe. Detailed drawings of the way the weld is made, as well as illustrations of the machines used in bending and rolling the pipe are included. Several pages are devoted to charts and tables of specifications.

Catalogs Wanted

The National School of Arts and Trades, of Lima, Peru, would be pleased to receive catalogs and other literature on metal- and wood-working machinery.

The Monarch Machine Tool Co., Sidney, Ohio, would like to have catalogs from makers of combined milling and gear cutting attachments for application to lathes.

Fonias Guillein, P. O. Box 25, Tampico, Tamanlipas, Mexico, requests catalogs and other literature concerning the manufacture and sale of machines for making steel brushes used in sweeping machines.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A manufacturing company in Mesopotamia desires to secure the representation of manufacturers of copper and brass sheets. Reference No. 257.

A commercial agent in Cuba desires to secure the representation of firms for the sale of iron and steel. Reference No. 260.

A manufacturing company in England desires to purchase a machine for making motor-car radiator tubes. Quotations should be given c.i.f. English port. Terms: Cash on receipt of machine. Reference No. 261.

An agency is desired by a firm in Wales for the sale of motorcycles and side cars of every description, of 6 hp. for side cars, and 4 hp. and 2¾ hp. for single cycle work. Quotations should be given c.i.f. Swansea or Bristol channel ports. Reference No. 276.

A commercial agent from Australia is in the United States and desires to secure the representation of manufacturers for the sale of goods throughout Australia, particularly in general mechanical lines. Reference No. 278.

A merchant in France desires to secure an agency for the sale of metallurgical supplies, agricultural machinery, automobiles, and all articles of a mechanical nature. Quotations should be given c.i.f. French port. Correspondence should be in French. Reference No. 279.

A retail merchant in Chile desires to purchase hardware, machinery and automobiles. Quotations should be given c. i. f. Talcahuano or Corral. Correspondence should be in Spanish or German. Reference No. 172.

A merchant in France desires to secure an agency for the sale of automobiles, automobile accessories, hardware, tools, and specialty lines. Reference No. 368.

Forthcoming Meetings

American Engineering Council: Annual meeting Jan. 5 and 6, at Washington, D. C. L. W. Wallace, secretary.

American Institute of Weights and Measures: Annual meeting Dec. 9, Engineering Societies Building, New York City. C. C. Stutz, secretary.

Society of Automotive Engineers: Annual meeting Jan. 11 to 13, Engineering Societies Building, New York City. C. F. Clarkson, secretary.

American Society of Civil Engineers: Annual meeting Jan. 18 and 19, Engineering Societies Building, New York City. Charles W. Hunt, secretary.

United Engineering Societies: Annual meeting Jan. 26, Engineering Societies Building, New York City. A. D. Flinn, secretary.

American Institute of Electrical Engineers: Mid-winter meeting Feb. 15, 16 and 17. Engineering Societies Building, New York City, F. L. Hutchinson, secretary.

American Institute of Mining and Metallurgical Engineers: Annual meeting Feb. 20 to 24, Engineering Societies Building, New York City. B. Staughton, secretary.

NEW *and* ENLARGED

Machine Tools and Machinery Wanted

Machine-tool wants published without charge

Conn., Bridgeport—Crane Co., South Ave., manufacturer of valves, etc.—annealing furnaces.

N. Y., New York—The Amer. Locomotive Co., 30 Church St.—
One No. 3 La Pointe broaching machine.
One No. 4 Cincinnati vertical milling machine.
Two 6-A automatic chucking and turning machines.
One 2-X automatic tapping machine.
One No. 3 universal milling machine.
One 5 ft. and one 3 ft. radial drill.
Two 2-B two spindle column type high speed drills, maximum capacity ⅞ in. hole in steel, 15 or 21 in. overhang.
One Colburn D-6 drill, 37 in.
One 10 in. vertical tool room shaper.
One 24 in. and one 18 in. pillar shaper.
One 12 x 60 in. plain grinder.
One 8 x 18 in. plain grinder.
One Heald grinder No. 70.
One Besly 29-53 vertical grinder.
One Besly 6 x 20 in. grinder.
One Greenfield cutter grinder.
One 12 x 36 in. universal grinder.
One No. 2 surface grinder.
One Low-Swing lathe, 4 x 84 in.
One 38 or 42 in. vertical turret lathe.
One 18 in. x 5 ft. engine lathe.
One 16 in. x 8 ft. tool room lathe.
One 18 in. x 8 ft. tool room lathe.
One 50 ton Lucas geared press.
Three 22 in. lever drill presses.
One No. 31 Lucas precision horizontal boring mill.
One Whitney hand miller.
One Cochran-Bly saw, 7 or 8 in. capacity.
One Peerless saw.

Pa., Hamburg—The Hamburg Boiler Wks. Co.—radial drill for drilling tube holes.

Pa., Philadelphia—Fanning & Schuett Mfg. Co., 502 Ruscomb St.—boring machines, lathes and drills.

Pa., Philadelphia—The Longacre Park Ice Co., c/o S. L. Brumbaugh, 1427 Walnut St.—equipment for garage including, lathe, drill press, grinders, etc.

Pa., Philadelphia—O. J. Maigne Co., 202 South Hutchinson St., O. J. Maigne, Pres.—lathe, 16 to 18 ft. screw cutting gear, motor attached.

Pa., Philadelphia — Roth-Buick Co., Frankford Ave. and Oxford Pike—drills, small lathe, air compressor and motors for service station.

Pa., Pittsburgh—The Amer. Natl. Gas Co., Park Bldg.—equipment for machine shop at Vandergrift.

Pa., Pittsburgh—The Pressed Steel Car Co., Farmers Bank Bldg.—one grinder.

Ala., Birmingham—The Stewart Hilty Machine Co., 1st Ave., W.—one heavy duty drill press to take 2¼ in. drill, 3 speed, to be used also for reaming, tapping, facing and countersinking.

Va., Richmond—H. R. Barr Co., 608 West Broad St.—one drill press and small lathe for auto repair work.

Va., Richmond—W. J. Harris Co., 820 West Broad St., W. J. Harris, Purch. Agt.—drill press and small lathes.

Va., Richmond—S. H. Long Co., 1011 West Broad St.—drill press and hand tools for auto repair work.

Ill., Chicago—C. Fuerman, 1532 Monroe Bldg.—one 9 in. bench lathe.

Ill., Chicago—G. Howe, 3656 North Francisan Ave.—spot welder for light gauge metal.

Ill., Chicago—The Underwriters Laboratories Inc., 207 East Ohio St.—one 2 to 3 ft. radial drill press, 2½ ft. preferred, arranged for or capable of being arranged for individual motor drive through gear box, or by variable speed motor.

Ill., Joliet—The Western Metal Products Corp., P. O. Box 1080, A. D. McIntyre, Pres.—One 3 to 10 ton traveling crane, 35 to 50 ft. span, 110 volt. One 2 stage air compressor about 4 in. x 8 in. and 4 in. x 4 in. Two centrifugal acid pumps, 3 in. x 4 in. discharge. One Kelly filter press, type 250, six leaves. Two centrifuges, large size, about 60 in. diameter bottom discharge.

O., Cleveland—The Co-operative Machine Co., 113 St. Clair Ave.—one 4-spindle 1¼ in. capacity automatic screw machine.

O., Youngstown—The Bd. Educ. 20 West Wood St.—tools for manual training schools, including 6-10 in. and 6-13 in. lathes.

Wis., Beloit—P. F. Mork, 94 State St.—lathe, vulcanizer and air compressor for auto repair work.

Wis., Clintonville—E. Heyer—special machinery for cylinder regrinding.

Wis., Janesville—C. E. Moore, 428 North Washington St.—lathe, drill press and grinder for small machine shop work.

Wis., Lancaster—Grant County, H. Mink, Highway Comr.—lathe, grinder, drill presses and electric motors, suitable for repairing road building machinery.

Wis., Milwaukee—The Backman Motor Co., 242 4th St. C. H. Backman, Purch. Agt.—drill press.

Wis., Milwaukee—The Eschenberg Sheet Metal Wks., 827 5th St., L Eschenberg, Purch. Agt.—One 8 in. gutter beater.

Wis., Milwaukee—The Federal Safety Mfg. Co., c/o J. E. Lee, 103 28th St.—drill press and motor.

Wis., Milwaukee—O. Herde, 191 23rd St.—one lathe.

Wis., Milwaukee—The Ideal Sheet Metal & Heating Co., 728 Pearl St., A. Schier, Purch. Agt.—one 10 in. gutter beater.

Wis., Milwaukee—The Poplar Garage, 6th and Poplar Sts., T. H. Merrill, Purch. Agt.—arbor press and power grinder.

Wis., Milwaukee—The Standard Sheet Metal Wks., 1184 24th St., J. Madis, Purch. Agt.—one square shear.

Wis., Milwaukee—The Wisconsin Sheet Metal & Furnace Wks., 636 12th St.—one 30 in. folder.

Wis., Sparta—The Atkinson Nash Co.—equipment for auto repair shop.

Minn., St. Paul—The Bd. Educ., L. G. S. Ferguson, Comr.—manual training and machine shop equipment.

N. Y., Buffalo—The Excelso Specialty Wks., 119 Clinton St.—one 12 x 15 printing press.

N. Y., New York—The Amer. Sugar Refining Co., 117 Wall St.—eight woodworking machines.

Pa., Fairchance—Wilson Bros. Coal Co., c/o C. Wilson,—belt and retarding conveyor for new coal tipple.

Pa., Norristown—Rambo & Regar, Main St.—knitting machines, reelers, spinners, etc. for proposed hosiery mill at Conshohocken.

Pa., Philadelphia—P. R. Devine Cut Stone Co., 2859 Tulip St., A. Devine, Mgr.—one double drum hoist and one portable forge.

Pa., Philadelphia—Farmers Cold Storage Co., c/o G. Sales, Liberty Bldg.—refrigeration machinery.

Pa., Philadelphia—Grubnau Bros., 2nd St. and Erie Ave.—carders, dryers, washers, looms, etc. for proposed wool factory.

Ala., Birmingham — The Birmingham Paper, 2101 Ave. E., T. M. McClellan, Pres.—complete machinery for the manufacture of corrugated paper boxes.

Fla., Archer—The Maddox Fdry. & Machine Co., Inc., H. Maddox, Pres. and Mgr.—one 5 to 6 ton compression ice machine, direct connected to a steam engine, with equipment for 2 cold storage rooms, 12 ft. x 24 ft.

Ky., Maysville—W. P. Farley Co.—complete machinery and equipment for bakery.

N. C., Sanatorium—H. Geiger—machinery for grinding sawdust for floor preparation.

Va., Ft. Royal—Gooney Manor Copper Co., Inc., H. E. Naylor, Vice Pres.—one Leyner water, air rock drill, steam driven air compressor of 150 cu. ft. per min. free air, 500 ft. ¾ in. or ⅞ in. wire cable for hoist, (must be in first class condition), also one 5,000 gal. tank for water reservoir, wood or steel.

Ill., Bloomington—Martens-Leary Co., manufacturer of vehicles, etc.—forge, vises and emery wheel.

O., Cleveland—E. S. Chamberland, 36 Murray St., New York, Purch. Agt. for the Natl. Tool Co. of Cleveland—several molding machines.

O., Columbus—The Gall Cure Collar Pad Co., 1675 South High St., D. S. Brown, Pres.—full line of machinery for the manufacture of horses collars and pads.

O., Orrville—The Sanderson Cyclone Drill Co.—one 10 ton crane.

Wis., Cudahy—Cudahy Bros., E. F. Lawler, Purch. Agt.—one nailing machine.

Wis., Hartford—The Church Hill Diary Co., c/o W. Hahn, Route 4—creamery machinery including separators, belt driven.

Wis., Milwaukee—G. O. Dallman, 375 Manitoba Ave.—one band saw and one circle saw.

Wis., Milwaukee—A. W. Schmidt, 997 Greenfield Ave.—mechanical baking equipment for proposed bakery on 23rd Ave.

Wis., Milwaukee—J. Schroeder Lumber Co., foot of Walnut St., E. J. Springer, Purch. Agt.—woodworking machinery to manufacture ice cream tubs and wooden pails, for plant at Two Rivers.

Wis., Plymouth—The Plymouth Weaving Wks., manufacturers of rugs, etc., W. F. Suckon, Purch. Agt.—weaving machinery and 4 looms.

Wis., Racine—The E. L. M. Tire Co., Deane Blvd.—special machinery and motors.

Wis., Wauwatosa—Modern Builders, Inc., Spring Ave. and Vliet St., R. Van Nostrand, Purch. Agt.—
One ¾ in. chisel mortiser, plunger type.
One 6 or 8 in. shaper.
One trim saw.
One 20 in. jointer.
One large band saw.
One 30 in. planer.
One sash sticker.

The Weekly Price Guide

This Week's Market

Blue annealed steel sheets, base size, are quoted at $3.28 as against $3.53 per 100 lb. in the New York warehouses. Reduction of 20c. also quoted on structural and cone head boiler rivets. Mill prices of structural steel still quoted at $1.50 for large tonnages; small lots $1.60.

Electrolytic copper is quoted at 14⅝c. as against 14¼c.; tin at 31⅝c. as compared with 30c. per lb. one week ago. Copper sheets are down ⅜c.; copper bars and tubing up ¼c. and brass rods, sheets and tubing advanced ¼c. per lb. in New York warehouses.

IRON AND STEEL

PIG IRON — Per gross ton — Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$22.50
Northern Basic	22.02
Southern Ohio No. 2	23.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	28.50
BIRMINGHAM	
No. 2 Foundry	18.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	23.26
Virginia No. 2	28.74
Basic	20.75
Grey Forge	22.50
CHICAGO	
No. 2 Foundry local	21.70
No. 2 Foundry, Southern, sil 2.25@2.75	24.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	22.46
Basic	20.96
Bessemer	21.96

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.25@2.50	3.28	3.10	3.38
No. 12	2.30@2.55	3.33	3.15	3.43
No. 14	2.35@2.60	3.38	3.20	3.48
No. 16	2.55@2.80	3.48	3.30	3.58
Black				
Nos. 17 and 21	2.60@2.85	3.80	3.55	3.95
Nos. 22 and 24	2.65@2.90	3.85	3.60	4.00
Nos. 25 and 26	2.70@2.95	3.90	3.65	4.05
No. 28	2.75@3.00	4.00	3.75	4.15
Galvanized				
Nos. 10 and 11	2.75@3.00	4.00	3.75	4.15
Nos. 12 and 14	2.85@3.10	4.10	3.85	4.25
Nos. 17 and 21	3.15@3.40	4.40	4.15	4.55
Nos. 22 and 24	3.30@3.55	4.55	4.30	4.70
No. 26	3.45@3.70	4.70	4.55	4.85
No. 28	3.75@4.00	5.00	4.75	5.15

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

Steel BUTT WELD Inches	Black	Galv.	Iron Inches	Black	Galv.
¼ to 3	68½	56	⅛ to 1½	44½	29½
LAP WELD					
2	61½	49	2	39½	25½
2½ to 6	65½	53	2½ to 4	42½	29½
7 to 8	62½	49	4½ to 6	42½	29½
9 to 12	61½	48	7 to 12	40½	27½
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
¼ to 1½	66½	55	⅛ to 1½	44½	30½
2 to 3	68½	56			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	59½	48	2	40½	27½
2½ to 4	63½	52	2½ to 4	43½	31½
4½ to 6	62½	51	4½ to 6	42½	30½
7 to 8	58½	45	7 to 8	35½	23½
9 to 12	52½	39	9 to 12	30½	18½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	63%	49%	60½%	47½%	60%	46%
3½ to 6 in. steel lap welded	54%	40%	58½%	44½%	57%	43%

Malleable fittings. Classes B and C, Banded, from New York stock sell at list less 5%. Cast iron, standard sizes, 32% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	5.00	6.00	4.28
Spring steel (light) (base)	6.00	6.00	3.68
Coppered Bessemer rods (base)	8.00	8.00	6.03
Hoop steel	3.53	3.14	3.28
Cold rolled strip steel	6.25	8.25	6.75
Floor plates	4.85	2.64@2.80	5.23
Cold finished shafting or screw	3.88	3.50	3.83
Cold finished flats, squares	4.38	4.00	4.35
Structural shapes (base)	2.78	2.64	2.88
Soft steel bars (base)	2.68	2.54	2.78
Soft steel bar shapes (base)	2.68	2.54	2.78
Soft steel bands (base)	3.28	....	3.48
Tank plates (base)	2.78	2.92½	2.88
Bar iron (2.00@2.10 at mill)	2.68	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire:			
⅜"	8.50		12@13
⅛	7.15		11@12
3/32 to ¼	6.75		10@11

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York	14.37½
Tin, 5-ton lots, New York	31.37½
Lead (up to carlots), St. Louis, 4.60; New York	5.00
Zinc (up to carlots), St. Louis, 4.97½; New York	5.37½

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.20	20.00	20.00
Antimony (Chinese), ton spot	5.50	6.50	6.00
Copper sheets, base	21.00	22.00	22.50
Copper wire (carlots)	16.50	17.00	15.75
Copper bars (ton lots)	19.75	24.00	19.00
Copper tubing (100-lb. lots)	21.25	24.00	22.50
Brass sheets (100-lb. lots)	16.75	17.00	18.25
Brass tubing (100-lb. lots)	18.50	19.50	20.00
Brass rods (1,000-lb. lots)	14.75	16.00	15.25
Zinc sheets (casks), (8% dis. carlots)	11.00	10.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	19.50	21.00	18.00
Babbitt metal (best grade)	22.00	39.75	34.00
Babbitt metal (commercial)	9.50	13.50	8.00

—Shop Materials and Supplies

MONEL METAL—Base price in cents per lb., f.o.b. Bayonne, N.J.:

Shot	35.00	Hot rolled machined rods (base)	53.00
Blocks	35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold drawn rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb.

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grades "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.75	10.25
Copper, heavy, and wire	9.50	10.75	9.50
Copper, light, and bottoms	8.00	8.25	8.25
Lead, heavy	4.00	3.75	3.75
Lead, tea	3.00	2.75	3.00
Brass, heavy	6.50	6.25	8.00
Brass, light	5.00	4.25	5.50
No. 1 yellow brass turnings	5.25	5.00	5.25
Zinc	3.00	2.00	2.75

TIN PLATES—American Charcoal Plates—Bright—Cents per lb

		New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:				
IC,	20x28, 112 sheets	20.50	19.00	18.50
IX,	20x28, 112 sheets	23.00	21.50	20.90
"A" Charcoal Allaways Grade:				
IC,	20x28, 112 sheets	17.50	16.75	17.00
IX,	20x28, 112 sheets	20.50	19.50	19.60
Coke Plates, Bright				
Prime, 20x28 in.:				
100-lb.,	112 sheets	12.50	12.00	14.50
IC,	112 sheets	12.80	12.30	14.80
Terne Plate				
Small lots, 8-lb. Coating:				
100-lb.,	14x20	7.00	6.10	7.25
IC,	14x20	7.25	6.35	7.40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb	.055@.09	.09	.10
Wiping cloths per M., 13¼x13¼	.....	55.00	55.00
Wiping cloths per M., 13¼x20½	.....	65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	3.50
Linseed oil, per gal., 5 bbl. lots	.72	.77	.76
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Fire clay, per 75 lb. bag		.80	1.00
Coke, prompt furnace, Connellsville	per ton	$3.00@3.15	
Coke, prompt foundry, Connellsville	per ton	4.00@4.50	

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	—60%	60-10-10%
1⅛ and 1¼x3 in. up to 12 in.	—40%	-60-10-10%	-60-10%
With cold punched sq. nuts	—30%	.....	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	—40%	.....	$4.00 off
Button head bolts, with hex. nuts	—20%	$3.90 net	.....
Hex. head and hex. nut bolts	—20%	.....	-65-5%
Lag screws, coach screws	—50–10%	.....	—60%
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	—50-10-10%	50-5%
Bolt ends, with hot pressed nuts	—50%	.....	—55%
Tap bolts, hex. heads	—20%	.....	.....
Semi-finished nuts all sizes	—70%	—75%	—80%
Case-hardened nuts	—60%	.....	.....
Washers, cast iron, ½ in., per 100 lb. Off list	$5.00	$5.50	$3.50 net
Washers, cast iron, ⅜ in. per 100 lb. Off list	4.25	3.75	3.50 net
Washers, round plate, per 100 lb. Off list	3.00	....	3.50 net
Nuts, hot pressed, sq., per 100 lb. Off list	2.00	3.00	4.00
Nuts, hot pressed, hex., per 100 lb. Off list	2.00	3.00	4.00
Nuts, cold punched, sq., per 100 lb. Off list	1.50	3.00	4.00
Nuts, cold punched, hex., per 100 lb. Off list	1.50	3.00	4.00
Rivets:			
Rivets, $\frac{7}{16}$ in. dia. and smaller	-50-10%	60-10-10%	-65-5%
Rivets, tinned	-50-10%	60-10-10%	4½c. net
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb (net)	$3.50	3.50	3.43
Cone heads, ditto (net)	3.60	3.60	3.53
1⅛ to 1½-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	0.15
⅞ in. diameter *EXTRA*	0.15	.....	0.15
½ in. diameter *EXTRA*	0.50	.....	0.50
1 in. long, and shorter *EXTRA*	0.50	.....	0.50
Longer than 5 in. *EXTRA*	0.25	.....	0.25
Less than 200 lb *EXTRA*	0.50	.....	0.50
Countersunk heads *EXTRA*	0.35	.....	$4.03 base
Copper rivets	—50–10%	—40-10%	—50-10%
Copper burs	—25–10%	—15%	—10%
Lard oil, pure, (50 gal. bbl.) per gal.	$0.90	$0.85	$0.90
Lard cutting oil (50 gal. bbl.) per gal.	0.60	0.50	0.55
Machine oil, lubricating, per gal.	0.45	0.35	.....
Belting—Present discounts from list in fair quantities (½ doz. rolls)			
Leather:			
Light grade	50–5%	50–5%	50–5%
Medium grade	45%	40–10–2½%	.....
Heavy grade	40%	40%	.....
Rubber and duck:			
First grade	50–10%	50–10%	.....
Second grade	60–5%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in.:			
No. 1 grade, per ream of 480 sheets,			
Flint paper	List $9.00 less 20-10-5%	50–10–5%'	-20-10%
Emery paper	List 11.00 less 20%	$11.00 net	-20%
Emery cloth	List 32.75 less 10%	32.75 net	-10%
Flint cloth, regular weight, width 3½ in., No. 1 grade, per 50 yd. roll, $4.50 net			list+10%
Emery discs, 6 in. dia., No. 1 grade, per 100.			
Paper	List $1.65 less 20%	.....	-10%
Cloth	List $3.55 less 10%	.....	-10%

Me., Harrisonville—The Harrison Ice & Creamery Co.—$5,500 worth of ice manufacturing equipment including compressors, machinery, belts, boilers, etc.

Tex., Plainview—The Texas Utilities Co., B. Scott, Mgr.—machinery for proposed ice cream plant at Lubbock.

Ont., Chesley—The Northern Textiles, Ltd.—machinery and equipment for woolen mill at Wiarton.

Metal Working Shops

NEW ENGLAND STATES

Conn., Bridgeport—Crane Co., South Ave., manufacturer of valves, etc., has awarded the contract for the construction of a 1 story, 75 x 175 ft. addition to its factory. Estimated cost, $70,000. Noted Nov. 24.

Conn., Torrington—The Union Hardware Co., 535 Migeon Ave., will soon award the contract for the construction of a 1 and 2 story, 60 x 300 ft. addition to its factory. Private plans.

Mass., Haverhill—The West Realty Co. has awarded the contract for the construciton of a 2 story, 70 x 181 ft. garage on Water St. Estimated cost, $100,000.

Mass., Springfield—A. A. Geisel, Pecousic St., is receiving bids for the construction of a 1 story, 40 x 400 ft. addition to his plant for the manufacture of auto parts. E. C. and G. C. Gardner, 33 Lyman St., Archts.

MIDDLE ATLANTIC STATES

Pa., Ellwood City—The Ellwood Forge Co., 10th St., has awarded the contract for the construction of a 1 story, 98 x 120 ft. forge plant.

Pa., Philadelphia—Fanning & Schuett Mfg. Co., 502 Ruscomb St., will receive bids until Dec. 10 for the construction of a 1 and 2 story, 50 x 120 ft. machine shop on 3rd and Cayuga Sts. Private plans.

Pa., Philadelphia — The Philadelphia Realty Co., c/o P. Eckert, 111 West Mt. Airy Ave., will build a 3 story, 22 x 218 x 306 ft. garage and repair shop on 48th St. and Woodland Ave. Estimated cost, $150,000.

Pa., Philadelphia — Roth-Buick Co., Frankford Ave. and Oxford Pike, has awarded the contract for the construction of a 1 story, 58 x 87 ft. sales and service station at 4653 Paul St. Estimated cost, $40,000.

Pa., Washington—Tyler Pipe & Tube Co. is receiving bids for the construction of a 1 story, 20 x 50 ft. and 50 x 50 ft. producers house and boiler plant. Estimated cost, $50,000. Simplex Eng. Co., Washington Trust Bldg., Engrs.

Pa., Yeadon—The Longacre Park Ice Co., c/o S. L. Brumbaugh, 1427 Walnut St., Philadelphia, will build a 1 story 32 x 32 ft. and a 1 story, 32 x 164 ft. garage and repair shop. Estimated cost, $40,000. J. T. Hoekstra, 1730 Sansom St., Philadelphia, Archt.

SOUTHERN STATES

W. Va., Fairmont—The Marion Motor Co., 304 Jacobs Bldg., plans to build a 1 story auto machine and repair shop.

MIDDLE WEST STATES

Ill., Chicago—H. J. Westbol, 1559 North Halsted St., will soon award the contract for the construction of a 1 story, 140 x 180 ft. garage. Estimated cost, $45,000. A. Comm, 3227 West Division St., Archt.

Ill., Highland Park—M. Ringdahl has awarded the contract for the construction of a 1 story, 73 x 125 ft. garage. Estimated cost, $48,000.

O., Cleveland—H. Barth & Son, 8801 Clark Ave., have awarded the contract for the construction of a 1 story, 84 x 110 ft. addition to their garage on Clark Ave. Estimated cost, $40,000.

O., Cleveland—E. W. Bliss Mfg. Co., St. Clair Ave. along tracks of New York Central R.R., is having plans prepared for the construction of a 1 story forge shop. Estimated cost, $40,000. Private plans.

O., Cleveland—A. W. Emerick Garage, 16205 St. Clair Ave., will receive bids until about Dec. 15 for the construction of a 1 story, 55 x 150 ft. garage on St. Clair and Holmes Aves. Estimated cost, $50,000. H. W. Steffens, 13000 Forest Hill Ave., Archt.

O., Cleveland—Moody & Thomas Milling Co., 6312 Kinsman Rd., is receiving bids for the construction of a 1 story, 50 x 190 ft. warehouse and garage on Park Ave. and East 66th St. Estimated cost, $50,000. L. R. Walker, 1907 East 66th St., Archt.

O., Cleveland—F. S. Plevits, 6613 Denison Ave., has awarded the contract for the construction of a 2 story, 50 x 80 ft. commercial building and garage at 6601 Deneson Ave. Estimated cost, $40,000.

O., Cleveland—The Schwenger-Klein Co., 515 Woodland Ave., manufacturer of butchers supplies, has awarded the contract for the construction of a 1 story, 90 x 120 ft. factory at 5501 Davison Ave. Estimated cost, $60,000.

O., Cleveland—The Stone Improvement Co., Kirby Bldg., is receiving bids for the construction of a 1 story, 100 x 150 ft. office and garage on East 83rd St. and Carnegie Ave. Estimated cost, $50,000. P. Matzinger & Co., Caxton Bldg., Archts. Noted Nov. 17.

O., Cleveland—Terrill Bros., 1360 Giel Ave., are receiving bids for the construction of a 1 story, 49 x 140 ft. garage at 14325 Euclid Ave. Estimated cost, $40,000. Private plans.

Wis., Milwaukee—M. Tullgren & Sons, Archts., 425 East Water St., are receiving bids for the construction of a 1 story, 60 x 120 ft. garage on Bway., for the Alliance Investment Co., 115 Wisconsin St. Estimated cost, $40,000. Noted Nov. 24.

Wis., Neenah—The Tri-City Nash Co., 526 South Commercial St., is having plans prepared for the construction of a 2 story, 55 x 150 ft. garage on North Commercial St. Estimated cost, $60,000. Private plans. Noted Nov. 24.

Wis., Sparta—The Atkinson Nash Co. has awarded the contract for the construction of a 2 story, 50 x 88 ft. garage on Main St. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

Ia., Malvern—A. Hall has awarded the contract for the construction of a 1 story, 40 x 60 ft. garage. Estimated cost, $40,000.

Kan., Parsons—The Missouri, Kansas & Texas R.R., Railway Exch. Bldg., St. Louis, Mo., has awarded the contract for the construction of a 1 story machine shop, here. Estimated cost, $50,000. Noted Sept. 8.

Neb., Omaha—Bergman & Henkens have awarded the contract for the construction of a 2 story, 60 x 60 ft. foundry on 11th and Grace Sts. Estimated cost, $40,000.

CANADA

Que., Montreal—The Bramsons Auto Co., Phillips Pl., plans to construct a 3 story garage on Ontario St. Estimated cost, $80,000.

General Manufacturing

Conn., New Haven—The Hull Brewing Co., 14 Whiting St., has awarded the contract for the construction of a 3½ story, 31 x 60 ft. manufacturing plant, etc., on State St. Estimated cost, $40,000.

Me., Sanford—The Goodall Worsted Co. has awarded the contract for the construction of a 1 and 5 story, 235 x 274 ft. storage, combing and spinning mill. Estimated cost, $600,000.

Mass., Haverhill—C. M. Hilley Bros. Co., 30 Pleasant St., will build a 7 story shoe factory on Water, Chestnut and School Sts. Estimated cost, $500,000. Noted Nov. 17.

MIDDLE ATLANTIC STATES

N. J., Homestead—The Atlas Finishing Co. has awarded the contract for the construction of a 3 story factory on Paterson Plank Rd. for finishing dies, etc. Estimated cost, $100,000. Noted Nov. 10.

N. J., Linden—Warner, Quinlan Co., 79 Wall St. New York City, is having sketches made for an oil refinery and asphalt plant here. Estimated cost, $2,000,000. Gifford, Hintze & Baker Eng. Corp., c/o L. B. Walkers, 227 Fulton St., New York City, Archts. and Engrs.

N. J., Pleasantville—P. E. Flotron Co., Lafayette Bldg., Phila., Pa., has awarded the contract for the construction of a 3 story, 100 x 130 ft. ice factory here. Estimated cost, $150,000.

N. Y., Buffalo—The Natl. Lamp Co., Nela Park, East Cleveland, O., is having plans prepared for the construction of a 1 story, 40 x 80 ft. boiler house and gas plant here. Estimated cost, $75,000. G. H. Johnson, Nela Park, East Cleveland, O., Archt.

N. Y., New York—The Family Laundry Corp., 1471 Wilkins Ave., has awarded the contract for the construction of a 2 story laundry on 5th Ave. and 141st St. Estimated cost, $400,000.

N. Y., Rochester — The Pennsylvania Glass Sand Co., 493 West Ave., is preparing plans for the construction of a 1 story, 45 x 105 ft. grinding mill on West Ave. Estimated cost, $50,000. Private plans.

Pa., Philadelphia—P. Hauck & Sons, 1227 North 4th St., have awarded the contract for the construction of a 3 story, 41 x 88 ft. box factory at 1233-35 North 4th St. Estimated cost, $27,000.

Pa., Philadelphia—The Rogers Hosiery Co., has awarded the contract for the construction of a 1 story, 80 x 150 ft. hosiery mill on Wyoming and Germantown Aves. Estimated cost, $29,000.

Pa., Templeton—The Templeton Limestone Co., Kittaning, will build a 30 x 60 ft. crusher plant and a 25 x 25 ft. power plant near here. Estimated cost, $50,000.

SOUTHERN STATES

Ga., Atlanta—The Atlantic Ice & Coal Co., Washington St. Viaduct, has awarded the contract for the construction of a 2 story ice plant on Murphy and Benjamin Sts. Estimated cost, $150,000.

La., Kenner—The Natl. Petroleum Co., Hibernia Bank Bldg., New Orleans, is having plans prepared for an oil refinery and extensive improvements to its holdings here. P. A. Leslie, mgr.

MIDDLE WEST STATES

Ill., Joliet—The Flint Sanitary Mills Co., c/o G. and T. Flint, is having plans prepared for the construction of a dairy. Estimated cost, $150,000. H. A. Hahn, c/o Davis-Watkins Dairymans Mfg. Co., Davis and 23rd Sts., North Chicago, Archt.

Ill., Naperville—The Kroehler Mfg. Co. is having plans prepared for the construction of a factory at 250 Front St. for the manufacture of lounges. Estimated cost, $35,000. Private plans.

Ill., West Chicago — Reid, Murdock & Co., Clark St. Bridge, Chicago, will soon award the contract for the construction of a 1 story condensing plant here. Estimated cost, $40,000. E. C. Blake, 810 Davis St., Evanston, Archt.

Ill., Zeigler—The Zeigler Ice & Bottling Co. is having plans prepared for the construction of a 2 story, 93 x 105 ft. ice plant. Estimated cost, $50,000. Keunerly & Stiegemeyer, Title Guarantee Bldg., St. Louis, Mo., Archts. Noted Nov. 24.

Wis., Dundas—The Calumet Packing Co., c/o P. M. Peacock, Secy., 309 Michigan Ave., Sheboygan, purchased a site and plans to build a 2 story, 60 x 85 ft. canning factory here. Estimated cost, $40,000. Architect not selected.

Wis., Fond-du-lac — The Combination Door and Screen Co., 180 Ruggles St., is having plans prepared for the construction of a 3 story, 50 x 50 ft. factory. Estimated cost, $45,000. B. E. Mehner, 6 East Division St., Archt.

Wis., North Milwaukee—The Ebony Ink Co., 82 Mason St., Milwaukee, has purchased a site on Villard Ave., here, and plans to build a 1 story, 42 x 120 ft. factory. Estimated cost, $25,000. Architect not selected.

Wis., Owen—The E. Z. Box Co. has purchased a site and plans to build a 2 story, 60 x 200 ft. box factory on Main St. Estimated cost, $170,000. Address G. E. Anderson, c/o Owen Lumber Co., Pres. Architect not selected.

WEST OF THE MISSISSIPPI

Mo., St. Louis—The Hartenbach Carpet Cleaning Co., Grand and Clark Sts., c/o H. C. Hartenbach, will soon award the contract for the construction of a 3 story, 30 x 75 ft. factory. Estimated cost, $40,000. Ludwig & Drusoerner, 3545 Humphrey St., Archts.

Mo., St. Louis—The Natl. Biscuit Co., c/o W. J. Rainalter Mgr., Main and Jule Sts., has awarded the contract for the construction of a 2 story factory. Estimated cost, $35,000. Noted Nov. 24.

Mo., St. Louis—The Polar Wave Ice & Fuel Co., Grand and Olive Sts., will soon award the contract for the construction of an ice plant on Gravois Ave. and Decolsey St. Estimated cost, $500,000. H. G. Clymer, Wainwright Bldg., Archt. Noted Oct. 13.

CANADA

Ont., Acton — The Acton Tanning Co. plans to rebuild a portion of its plant which was recently destroyed by fire. Estimated cost, $25,000.

Ont., Kincardine—F. B. Coombe Furniture Co. plans to build a 3 story, 50 x 80 ft. addition to its factory. Estimated cost, $50,000. Private plans.

Ont., Port Elgin—E. Grandier, of Teasdall Hosiery Co., London, plans to construct a hosiery mill here. Estimated cost, $40,000.